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HARVARD UNIVERSITY
ARNOLD ARBORETUM
PRESENTED BY CHARLES SPRAGUE SARGENT
1892

~~DEPOSITED AT THE~~
~~HARVARD FOREST~~
1943

RETURNED TO J. P.
MARCH, 1967

tl

1906.

MEMORANDUM by G. A. JULIUS, Esq., B.Sc., M.E., Officer-in-Charge of all Testing Operations on behalf of the Railway Department of Western Australia.

"The whole of the Timbers of Western Australia are now being tested in every possible way, both physically and chemically. Some 12,000 tests are being made, chiefly on a 10-ton Buckton Testing Machine of the most modern design.

The nature of these tests is vastly beyond anything that has ever been attempted in Australasia, and the Timber used in the tests varies from 2in. x 2in. to 12in. x 20in.

The information thus derived is being made as conclusive and authoritative as possible, and the results are being prepared in such a form as to make them specially useful for Engineering works.

Heretofore the information available respecting the strength and capabilities of Western Australian Timbers has been somewhat contradictory, various tests having been made at different times by different persons; but in no case has any attempt been made by any one of such persons to clearly demonstrate the relative strength of our Timbers under varying conditions of Moisture and Seasoning. These two factors, of course, bear very largely upon the strength and life of our Timbers hence the tests now being conducted will be made specially complete in connection with determining the relationship between Moisture percentage and Strength. To satisfactorily determine these points, a considerable number of tests are necessary, and a large staff of men are engaged upon the work, both by night and day.

Certain statements which have been circulated in the past by some of the Australian Governments, dealing with tests of Timbers conducted by Professors Warren and Kernot, have shown poor results so far as Western Australian Timbers are concerned. This has been chiefly attributable to the fact that such tests were based upon very few, and at the same time very poor, specimens.

At this date about 70 per cent. of the tests are completed, and from six to eight weeks will be occupied in finishing the work. Every effort is being put forth to have the Report furnished within the latter period, so that it may be issued as a Supplement to the "Notes *re* Timbers of Western Australia suitable for Railways, Engineering Works, and Constructional Purposes Generally."

The average results now being obtained are very much higher than those quoted in the reports of the above-mentioned gentlemen, and compare extremely favourably with any tests of Timber obtained from the other States of the Commonwealth of Australia, or from any other part of the World."

C. H. RASON,
Premier of Western Australia.

Perth, 31st March, 1906.

1906.

1906.

WESTERN AUSTRALIA.

NOTES

RE

TIMBERS OF WESTERN AUSTRALIA

SUITABLE FOR

RAILWAYS, ENGINEERING WORKS,

AND

CONSTRUCTIONAL PURPOSES GENERALLY.

Issued under the Authority of

The Hon. NEWTON J. MOORE, M.L.A.,

Minister for Lands and Agriculture.

PERTH:
BY AUTHORITY: A. CURTIS, ACTING GOVERNMENT PRINTER.
1906.

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TIMBER RESOURCES.

The State of Western Australia lies approximately between the 14th and 35th parallels of South Latitude and the 113th and 129th degrees of East Longitude, and covers an area of about 975,920 square miles, or 624,588,800 acres of territory, being thus nearly 17 times the size of England and Wales, with a coast line of rather over 5,000 miles. In the South-Western portion of this vast area there are large belts of hardwood forests providing timbers of commercial value for constructional purposes, viz.:—Jarrah, Karri, Tuart, and Blackbutt, the most notable among these being Jarrah and Karri, which largely exceed the others in marketable quantity. The following are also valuable timbers for their own special and chiefly local purposes, viz.:—White Gum (Wandoo), York Gum, and Red Gum.

Among miscellaneous trees may be mentioned Sandalwood (exported to countries of the far East), Mallet gum (the bark of which now finds a large foreign market for the tanning industry), Yate (use by settlers for general farming requirements), Morrell Gum, Salmon Gum, Gimlet, and other woods (employed for mining timbers and general purposes); and Jamwood, which is very durable for fencing.

In the North-West and Northern portions of the State are frequently found large patches of other hardwoods suitable and used for many local purposes; but the sparse settlement of this portion of the country, and the difficulties and cost of working, transportation, and freight have so far precluded any of these woods being utilised beyond their own immediate districts.

In the following notes only the seven principal timbers above-mentioned, viz., Jarrah, Karri, Tuart, Blackbutt, Wandoo, York Gum, and Red Gum, will be further considered.

Full botanical and technical information as to these and all other varieties of the Flora of Western Australia generally are available in the "Report on the Forest Resources of Western Australia," by Baron von Mueller, F.R.S.; the Monograph on "The Forests of Western Australia," by the late Mr. Ednie Brown, Conservator of Forests for the State; and other publications.

FOREST AREAS.

The total Wooded Area of Western Australia is estimated at some 98,000,000 acres; and the extent of merchantable timber has been reckoned to be approximately as follows:—

	acres.
Jarrah mainly (with Blackbutt and Red Gum interspersed)	8,000,000
Karri	1,200,000
Tuart	200,000
Wandoo (White Gum), and Allied Timbers	7,000,000
York Gum, Yate, Sandalwood, and Jamwood	4,000,000
	20,400,000

Over the remainder of the wooded area (with, however, a few marked exceptions), the timbers are mostly either of smaller class, and hardly available for more than miscellaneous local uses, or are at present, for reasons of locality, etc., practically confined thereto.

DISTRIBUTION.

The general distribution of the principal trees has been thus well indicated:—

> The true forest region of Australia is almost entirely coastal; that is to say, the most luxurious tree-growth is confined to the mountain and hill ranges, which to a large extent follow at a moderate distance the trend of the coast, and to the tablelands and foothills which stretch from these towards the shore line. Where, however, the ranges approach closely to the ocean, as is the case with the Darling Hills in Western Australia, the forest belt may extend beyond the watershed some distance inland, its limits being clearly marked by a greater rainfall and a more temperate climate. Thus, in Western Australia, the great belt of jarrah, some 350 miles in length, which stretches eastward from the Darling Ranges, has a distinct but narrow belt of tuart between it and the coast. Within the extensive tract of jarrah, in the extreme south-western part of the State, is the main karri belt, stretching from Cape Hamelin to Torbay, and lying between 115° and 118° east longitude and 34° and 35° south latitude. This region, in which the jarrah, karri, tuart, blackbutt, and red gum are the principal trees, has an annual rainfall varying from 35 to 40 inches. In the somewhat drier districts stretching eastward of the jarrah belt, there is a fairly wide strip of white gum enclosing a narrower belt of York gum, which, as regards its northern and southern limits, is almost coterminous with the jarrah. Eastward of this again, where the annual rainfall is some 14 inches and under, the forest changes first to a poorer growth of white gum, and in the goldfields region to the trees locally known as salmon, morrell, and gimlet gums, with some belts of pine at intervals.

This distribution is generally exhibited on the accompanying map.

CLIMATIC CONDITIONS.

The main climatic features prevailing over the South-Western portion of the State are described by the Government Astronomer and Meteorologist (Mr. W. E. Cooke, M.A., F.R.A.S.), in Appendix A. From this it may be gathered that temperature, rainfall, and equable seasons are alike favourable not only to the substantial and sound growth of the forest belts, but also to the carrying on of milling operations within them.

SOME SPECIFIC ATTRIBUTES OF THE EUCALYPTS.

The chemical and microscopical examination of eucalyptus woods generally discloses certain special qualities, thus interestingly described by Baron von Mueller:—

> It may be summed up that the capability of different kinds of eucalyptus wood to endure for lengthened periods destructive contact with humidity, air, and temperature depends largely, and perhaps mainly, on phlobaphenic substance, unchangeable by water; further probably also on the occurrence of oleo-resin, on the reduced number of hollow vascular tubes, on the organisation of the walls of the ligneous fibre, on the decreased copiousness of parenchymatic substance, and on the lesser space occupied by the medullary rays. The hard variety of Jarrah wood fulfils most of these conditions, eminently so of the first one.

BRIEF GENERAL DESCRIPTIONS OF THE PRINCIPAL TREES AND TIMBERS.

Jarrah (*Eucalyptus Marginata*).—It is not uncommon to find areas of Jarrah forests where many of the matured trees attain heights from 90 to 120 feet, with fine straight stems three feet to five feet in diameter, and 50 feet to 60 feet to the first branch. Taking, however, a general average of these forests, a Jarrah tree of good stamp, and one representing a fair specimen of its kind, would run about 90 to 100 feet in height, and from 2½ to 3½ feet in diameter at the base. Many individual trees attain much greater dimensions than those named. When a diameter of 2½ feet has been reached, the timber is considered fit for the saw-mill.

Jarrah weighs about 70lbs. per cubic foot when first cut, and about 60lbs. when seasoned. The wood is of a reddish colour, very hard and dense, and generally straight in the grain, with moderately interlocking fibres, and shows very little sapwood, generally under one inch. The Red Mahogany of New South Wales has sometimes been confused with Jarrah, with which, however, it cannot reasonably be compared.

Karri (*Eucalyptus diversicolor*).—This is one of the finest and most graceful trees in the forests of Australia. When matured and of large dimensions its appearance is very striking. The height of the average tree is about 150 feet, running to six feet in diameter three or four feet from the ground, and about 100 to 120 feet to the first branch. In the Warren River district it is not unusual to meet with occasional trees 300 feet in extreme height, over 180 feet in height to the first limb, and from 20 to 30 feet in circumference at the base. The timber weighs about 63lbs. per cubic foot when fairly seasoned. It is red in colour, heavy, tough, dense, elastic, and closely similar to Jarrah in appearance.

TUART (*Eucalyptus gomphocephala*).—Tuart attains a maximum height of 150 feet, and a maximum girth of about 22 feet, but an average diameter would be about three feet. As a rule, it is widely branched, with a stem of about 40 feet up to the first limb. The wood is of cream colour, very hard, dense, and interlocked in grain, and generally considered about the strongest and toughest growing in the State, and one of the heaviest, weighing about 70lbs. per cubic foot when seasoned. This timber is in demand for construction where special strength and hardness are required, but the supplies are not extensive enough to provide for general use.

BLACKBUTT (*Eucalyptus patens*).—The Blackbutt does not grow in defined forests by itself, but is scattered over the Jarrah and Karri areas. It may attain a height of 120 feet and a diameter of six feet. The timber is light in colour, hard, and dense, and so tough as not to yield to ordinary splitting processes, and has proved very durable underground.

WANDOO (*Eucalyptus redunca*).—This tree, better known locally, perhaps, as White Gum, is widely distributed. Trees of average size attain the height of 60 to 80 feet, with an average diameter of 2 to 3 feet. It grows, as a rule, in fairly open country. The timber is brownish-red in colour, very hard, dense, strong, and durable, and even when fully seasoned weighs up to 70lbs. per cubic foot.

YORK GUM (*Eucalyptus loxophleba*).—This does not grow to heights much above 80ft. or diameters exceeding 3ft., and the stem is apt to be more or less gnarled. The wood is reddish in colour, and is exceedingly hard, heavy, dense, and tough, and weighs about 68lbs. per cubic foot when seasoned.

RED GUM (*Eucalyptus colophylla*).—This tree is widely distributed and of very handsome appearance, growing to heights of over 100ft., and an average diameter of about 3ft. The wood is yellowish-red in colour, of lighter weight than the other local Eucalypts, though fairly dense and hard, and splits readily. It is apt to be much intersected by gum veins, which impair its suitability for important or permanent works of construction. The exuding gum has an acknowledged value for medicinal and tanning purposes.

AVAILABLE SUPPLIES OF COMMERCIAL TIMBERS.

The State Royal Commission on Forestry which sat in 1904, and took very exhaustive evidence, reported to the following effect upon the available supplies of Jarrah, Karri, Tuart, and Blackbutt:—

SUPPLIES OF JARRAH.—Virgin Jarrah forest to the North of Blackwood River, and suitable for milling, is estimated at 2,000,000 acres. Based on the present rate of cutting, this would be equivalent to about 32 years' supply. To the South of the Blackwood River there are also considerable supplies of this timber; but being so constantly intergrown with Karri, Blackbutt, and Red Gum, no fair estimate of quantities can be given.

In addition to these areas there are several millions of acres of Jarrah country not of sufficient commercial value for milling purposes, but which will, as the railway system develops, afford immense scope for sleeper-hewing.

Supplies of Karri.—This timber is limited to the tract of country lying between Margaret River and the Porongorup Range, about 1,200,000 acres of which is under Karri. The highest type of this magnificent tree is found in the neighbourhood of the Warren River. Of the area mentioned above, some 150,000 acres have been cut over at Karridale, Torbay, and Denmark, leaving an area of over 1,000,000 acres of virgin forest, estimated to be capable of supplying 12,000,000 loads of Karri in the round.

Supplies of Tuart.—The area covered by this timber is very limited in extent, being practically confined to a narrow strip near the coast lying between Fremantle and Busselton. Some portions of this area have been alienated from the Crown, but the best-timbered portions have been reserved. The approximate extent arrived at, through local knowledge of the members of the Commission, is 100,000 acres, carrying about 150,000 loads of timber.

Supplies of Blackbutt.—It is impossible to arrive at the areas over which Blackbutt grows, because it is so closely associated with Jarrah, Karri, and Red Gum that the greatest difficulty would be experienced in making anything like a reliable estimate. The home of the Blackbutt is in the gullies and gorges of rich flats of the Darling Range, and no better example of its growth can be seen than in the valley of the Hamilton River in the Collie District.

AVAILABLE SUPPLIES OF OTHER TIMBERS UTILISED FOR VARIOUS PURPOSES.

Supplies of Wandoo.—Wandoo, or White Gum, though existing over a very considerable area of country, is thinly distributed, and does not develop very large sizes. It is found in its best form in a belt of country North and South on the Eastern flank of the Jarrah forests. Portions of White Gum country apart from the above are being rapidly converted into wheat fields.

Supplies of York Gum.—This timber occupies a long tract of country some miles in width, principally on the central Eastern slope of the Darling Ranges. The area covered cannot well be estimated, as it is so largely intermingled with Wandoo.

Supplies of Red Gum.—This tree is intermixed with the Jarrah, Wandoo, York Gum, and Karri forests, and grows abundantly along the railway lines to Bunbury and Boyanup, and other places where the country is low-lying and the soil of a loamy nature.

CONSUMPTION OF TIMBER.

In the Report of the State Royal Commission on Forestry, 1904, it is estimated that the Jarrah forests are at present being depleted at the rate of some 60,000 acres per annum, and that the existing leases of Karri having been practically cut over, no more can be cut pending the opening of new forests. It is added that the areas of cut-over Jarrah and Karri forests are about 530,000 acres and 150,000 acres respectively.

EXPORT OF TIMBER.

Substantial and increasing trade in the export of Western Australian Timbers has grown up of recent years, but has so far been largely confined to Jarrah and Karri, principally as sleepers and material for wood-paving; though these woods have also found a fairly large market abroad for piles and general constructive purposes. Occasional shipments of Tuart and Blackbutt have been made.

The total value of exported timber for the 10 years, 1895 to 1904, amounts to £4,083,122, and for the year 1904, to £654,949; figures which speak for themselves.

In Appendix B is given a summary return for the 10 years mentioned above. In the case of the last year (1904) details are added of the general nature of the shipments and the countries to which they were despatched, showing that the trade in Western Australian hardwoods extends to many parts of the world.

ECONOMIC USES OF THE PRINCIPAL TIMBERS OF THE STATE.

The main economic uses of the principal timbers may be briefly described as follows:—

Jarrah.—This timber is the most generally employed for railway construction, railway sleepers, marine and engineering works of all kinds, and building construction; and is specially suitable for underground use, and where in contact with wind and water.

The qualities of Jarrah as a timber for general constructional purposes are thus summarised by Mr. O'Connor, M.Inst.C.E., the late distinguished Engineer-in-Chief of the State:—

> For durability and general construction work of all classes Jarrah is undoubtedly one of the best of all State timbers. It is almost exclusively used throughout the State in railway construction work, as sleepers, piles, bridge beams, etc., and shows great durability both in and above ground.
>
> Piles in river bridges erected 54 years have been withdrawn and found perfect in every respect.
>
> For wharves and jetties Jarrah is exclusively used throughout the State, and piles withdrawn therefrom, after having been in position over 30 years, have been found to be almost as good as the day they were driven.

Mr. Palmer, M.Inst.C.E., who succeeded Mr. O'Connor as Engineer-in-Chief, supplemented the opinions expressed by him, as follows:—

> In addition to the uses more particularly dealt with by Mr. O'Connor, Jarrah has been employed more or less in all classes of building operations in this State, and as its qualities have become better known, and the difficulties inherent in working so dense and hard a wood have been overcome, its employment has been increasingly great.
>
> It has, of late years, been used almost exclusively in public buildings, more especially in connection with engineering works; in railway platforms, fencing, and kerbing, wall frames with bricknoggings or weatherboards, verandah posts, roof timbering and beams, and in fact wherever lightness is not a desideratum; and for such uses possesses the special quality of not suffering from rot when built into masonry or let into the ground.
>
> In buildings where there is much traffic, and also in private houses, jarrah planks furnish a durable cleanly floor, capable, if desired, of high polish. Skirtings, dados, rails, architraves, door frames, transoms, mullions, doorsteps, staircases, mantlepieces, and furniture, more particularly in public buildings and large houses, have been, and are being, increasingly made of this wood, with very handsome results.

Mr. Moncrieff, M.Inst.C.E., M.Am.Soc.C.E., Engineer-in-Chief of South Australia, writes as follows:—

> Jarrah has been used for railway sleepers, in the construction of bridges, wharves, and jetties, and for general work in buildings such as goods-sheds and platforms, where a heavy durable timber was required; and where the timber was of full growth, and seasoned before use, it has in every case proved satisfactory.

The Secretary of Public Works of Victoria reports as to use of Jarrah in that State:—

> This Department has used Jarrah in piles, walings, etc.; and it is at present being somewhat extensively used in the substructures of timber buildings with success. The piles have not been driven in waters in which the *Teredo Navalis* is established, and it cannot be said that Jarrah would resist the attack of this pest; but for marine, bridge, and general purposes, Jarrah might equally be used with the best of our local timbers. Jarrah is now being extensively used for weather-boarding, etc., in Melbourne and suburbs, and for this it is an excellent material.

As regards the value and advantages of Jarrah for use as railway sleepers, a full account is given further on in the special report by Mr. Dartnall, M.Inst.C.E., Chief Engineer of Existing Lines for Western Australia.

Many other favourable and occasionally enthusiastic opinions as to the reliability, strength, and durability of Jarrah for all general engineering purposes might be given, but the qualities mentioned should stand sufficiently vouched for by those quoted above, and it is not proposed to here add to them. Neither, since the essential object of these notes is throughout to afford a reasonably concise review of the principal timber resources of Western Australia on their direct merits, is it proposed to enter into controversial matter such as the relative qualities for use as piles of the Jarrah of Western Australia, and the Turpentine and other timbers of the Eastern States of the Commonwealth, except to mention that the introduction of such matter into publications by the New South Wales and Queensland Governments has necessitated the issue of a special pamphlet in defence of Jarrah piles.

Amongst uses not mentioned above, Jarrah has been employed for railway-wagon construction by English Railways and Western Australian Timber Companies with satisfactory results; is very largely used for street-paving blocks; is placed by Lloyds in the third highest class for ship-building purposes, and below Ironbark only of Australian hardwoods; takes the chief place in local shipbuilders' yards; and for telegraph and telephone poles, and signal posts is found exceedingly suitable and durable; while its miscellaneous uses in the State generally, for almost every purpose and requirement of all the industries, are innumerable.

KARRI.—This timber is largely used on the Government and private railways of the State for car and wagon frames and bodies with much advantage, as illustrated in the special report further on by Mr. E. S. Hume, Chief Mechanical Engineer for the State Railways. It is also employed for bridge timbers, flooring, planking telegraph pole arms, felloes, shafts, and fruit cases, and is in high repute and very wide use for street-paving blocks, being considered by many municipal surveyors as equal to Jarrah for that purpose; but is not well suited, as a rule, for underground work, or in damp situations. Piles of unusual straightness and regular taper, of either ordinary or exceptional lengths (up to 100ft. and over), can be obtained with facility and in large quantities, and have been not a little used unprotected in water not infested with marine pests. Karri also readily affords baulks of exceptional section and planks of great width.

TUART.—This timber is used in the framework of railway wagons, buffers, engine bearers, ships' beams, bridge supports, deck planks, shafts, naves, and felloes; and especially in wheelwrights' work generally, including wheels of the large timber whims in the forest, for which purpose it is practically preferred to iron. It is particularly in demand where special strength and hardness are necessary; and Laslett states that it is one of the strongest timbers known, whether tested transversely or otherwise.

BLACKBUTT.—Used mostly, so far, for local purposes, such as settlers' steadings, fences, wheels, shafts, and farming implements generally; but suitable both for sleepers and street-paving, and for piles and main members of inland bridges and similar structures. For railway wagon building, Blackbutt is largely used by the Milling Companies, and has been shipped to Railway Companies abroad for the same purpose. It is also now being cut for lining and some other house-building requirements, and ships' spars are occasionally made from it. Though rather expensive to work up, results from its use justify the extra cost.

WANDOO.—For railway sleepers this timber is deemed to rank equal to Jarrah; and is also used for short piles, and for bridge and wharf planking, etc., in permanent works, when conveniently procurable. It has been and continues to be freely and very successfully employed for both wheelwrights' and millwrights' work, for which its extreme hardness, especially when seasoned, is particularly appreciated; for ribs, bends, and knees in lugger and boat building; and for mining timbers: while it serves to provide very durable fencing, stockyards, and other settlers' wants.

York Gum.—The principal use of this timber has been in naves, felloes, and all kinds of wheelwrights' work, its acknowledged peculiar excellence for which is recognised beyond the limits of the State. It is also employed for several local and farming requirements.

Red Gum.—This timber has not been very largely utilised up to the present, for the reason that numerous gum veins are apt to intersect it. Notwithstanding this, it is freely and advantageously employed in short lengths for such purposes as axe and other handles, spokes, naves, fencing rails, harrows, shafts, and other farming necessities, and for fruit cases, buggy-springs, and levers; while in longer lengths, very good round spars can be provided. The timber is strong and tough, but not very durable underground.

General.—Jarrah timber can be and is applied to constructional and general purposes of every kind with the best results and advantage; and is eminently and specially suitable for flooring, for which use it can more than hold its own with any known timber, affording an exceptionally homogeneous surface, extremely durable under the heaviest and most continuous traffic, such as that of large halls, public buildings, railway stations, etc.; while for high class floors, such as those of mansions, ball rooms, etc., an evenness and perfect polish can readily be produced which it would be practically impossible to excel.

Many of the Western Australian woods are used and are very suitable for furniture, cabinet work, carving, turnery, mouldings, and other purposes of arts and crafts, for which they take a high finish, and for minor parts of railway carriages. They vary in colour from cream through yellows, reds, and browns, to nearly black, while some are attractively mottled or variegated, and several are highly scented.

DISTINGUISHING BETWEEN JARRAH AND KARRI.

It is always rather more or less difficult for anyone not constantly dealing with the two timbers (when cut) to at all surely distinguish one from the other.

The following test is the simplest, and the most generally and readily applied, though it can hardly be regarded as altogether reliable:—A splinter struck from Jarrah, and placed in a flame, generally burns to a firm black ash, one from Karri to a somewhat woolly white ash; also, when the flame of the burning splinter is blown out, Karri tends to glow for some little time, Jarrah to go black out quickly.

The only sure way, however, for purchasers of the timbers is to obtain the good offices of the Government of the State towards the execution of any special order being carried out under the superintendence of the Woods and Forests Department, with a view to timber under order being branded with a distinctive mark as it comes from the sawn log. The difficulty of distinguishing arises only with the timber when cut. In the forest, or with the bark on, the distinction is very clear and marked, Jarrah having a rough, broken, deep-coloured bark, Karri a smooth, clean, light-coloured whole bark, while the trees are in other respects dissimilar.

HEARTWOOD AND SAPWOOD.

Contrary to general practice in the case of other chief timbers of the world, the heartwood core of the Eucalypts is to be avoided. In Western Australian woods, this applies specially to Jarrah, Karri, Blackbutt, and Wandoo, and generally to others. Specifications for cut timbers should therefore require freedom from heartwood, except in the case of piles, which are better round than squared.

Sapwood, on the other hand, rarely measures above an inch in thickness; and being often almost as hard as the inner wood, hardly needs to be particularly excluded except in cases of special importance.

SEASONING.

Every class of Eucalyptus timber benefits materially by being stacked for seasoning purposes. The practice in the State is to strip and stack at the mills for at least 12 months all timber intended for joinery work, house-building, flooring, etc. The custom of putting into almost immediate use freshly cut sleepers and bridge timbers, and letting them season in the work, is somewhat prejudicial to the life of the timber; appreciably better results would be obtained by stacking out for seasoning before use. This, of course, entails some little extra expense which would, however, be well compensated for by the lengthened life of the timber.

NON-INFLAMMABILITY.

The British Fire Prevention Committee made some careful inflammability trials with Jarrah and Karri timber a few years ago, with a view of obtaining reliable data as to their fire resistance capabilities, when severe tests were applied. The results were regarded as generally satisfactory, and as indicating that a building constructed of Jarrah or Karri would be unusually resistant to fire, especially in the case of floors and floor beams. Tuart is about equally resistant, while Blackbutt is especially mentioned by the State Royal Commission as being notably non-inflammable.

DURABILITY.

Jarrah.—The late Conservator of Forests, Mr. Ednie Brown, remarked upon the durability of Jarrah as follows:—

> The suitability of this timber for piles or any works requiring immersion in salt or fresh water has been practically noted. In this office there are specimens which have been obtained from piles and girders 60 years old. These were driven and used in local harbours and bridges. The timber appears to be perfectly sound, and free from any signs of decay. If anything the wood seems to be harder, more solid, and apparently more durable than freshly cut timber.

Baron von Mueller speaks of Jarrah as follows:—

> This timber is destined to supply one of the most lasting of hardwood timbers for a long time to come, at the least costly rate, to very many parts of the world.

Mr. O'Connor, the late Engineer-in-Chief, stated:—

> For durability Jarrah is undoubtedly one of the best of all State timbers. It shows great durability both in and above ground. Piles in river bridges, erected 54 years, have been withdrawn and found perfect in every respect. Piles withdrawn from wharves and jetties after having been in position over 30 years have been found to be almost as good as the day they were driven.

Karri.—It is not generally considered that Karri is a suitable timber for underground works or placed in water, but there are records of its being used under such conditions for 30 to 40 years with only a very small amount of decay. In superstructure works of wharves and jetties it has been taken out after 20 years' service, and found not only practically as good as when first emplaced, but even better, being perfectly sound throughout and extraordinarily hard, so as to be almost unworkable with ordinary tools. Karri piles have also lasted for long periods where the conditions have been favourable.

Tuart.—In consequence of the comparatively small quantities of this timber so far used, definite information is hardly available under this head. The late Conservator of Forests, however, reports a case of a slab of Tuart that had been lying on the ground exposed to the weather and white ants for over 20 years without injury; and all occasional uses by settlers and others, from the early days of the Colony, point to a durability hardly inferior to that of Jarrah. In railway wagons Tuart bolsters in continual service for 13 years have been found perfectly sound and solid.

Blackbutt.—Mr. Hastie, Timber Inspector, in his evidence before the Royal Commission on State Forests, said:—

> I know some logs which were lying down about 53 years ago, and they look as well to-day as ever.

Mr. Ednie Brown says:—

> This timber appears to last well underground. An instance was shown me where slabs of the timber used 20 years ago in the construction of a cattle yard were quite sound, with the exception of a little decay between wind and water. Another instance of its durability came under my observation in the case of fence posts of the wood which had been in the ground for 50 years.

Railway wagons built of Blackbutt, and used continuously for ten years in the heaviest and roughest traffic on the mill lines, have withstood the same most successfully, being almost as good and sound at the end of the period as when first constructed.

Wandoo.—As to this timber, the late Conservator of Forests remarked as follows:—

> At Pingelly I was shown a fence post which was said to have been nearly 50 years in the ground. This appeared to be in a perfectly sound condition.

The Railway Department, in reporting the result of Wandoo sleepers laid on the Newcastle line as a test, states:—

> About 150 of these sleepers were put in about 17 or 18 years ago, when the line was constructed. Fully 90 per cent. of them are, to all appearance, as good as new, being very hard and sound, and they will in all probability last yet for many years. A few of the sleepers were slightly decayed on the outside, but on scraping off about a quarter of an inch the remainder of the timber was found in each instance to be perfectly sound.

RESISTANCE TO TEREDO, WHITE ANT, AND DRY ROT.

Teredo.—In temperate zone waters unprotected Jarrah does not suffer any visible injury from teredo or other marine borers; and throughout Australasia piles, walings, and bracings in sea jetties, after being in position over 30 years, have been found practically as good as when first fixed. In tropical waters, however, as with practically all other known timbers, sheathing with Muntz metal is necessary.

Karri unprotected is not proof against marine borers, and should not be employed for piles where they are present, though there are not a few instances of successful use in river waters where borers do not seem to be active. When sheathed with Muntz metal, however, Karri piles have proved satisfactory. They can be procured longer and straighter than Jarrah.

White Ant.—Jarrah and Wandoo are practically proof against white ants in the temperate parts of the State, while Tuart and Blackbutt are rarely attacked.

Some of the smaller trees, particularly Jamwood in the South, and Blackheart, Bloodwood, Coolibah, and others in the tropical regions seem to be immune from the ant; and for that reason are advantageously employed for fences, stockyards, house-blocks, and other situations most exposed to its attack.

Dry Rot.—Neither Jarrah, Tuart, nor Wandoo are liable to attack by dry rot, unless under conditions exceptionally favourable to its development. Karri, however, seems somewhat prone to this pest; while as to Blackbutt, there is not sufficient reliable information so far in this respect.

STRENGTH OF WESTERN AUSTRALIAN TIMBERS.

In the year 1895—some two or three years after the marked advance of the Colony, owing to the institution of Responsible Government and the gold discoveries, had justified that active policy of large public works which has since been continuously sustained—the data as to the strength of the principal timbers were carefully re-investigated, and, in the absence of means and opportunities for satisfactorily conducting local tests, all available records were examined, and a short series of tables collated. In 1896 these were embodied for the general guidance of the Public Works Department in a memorandum by the Engineer-in-Chief (Mr. C. Y. O'Connor, M.Inst.C.E.), which is reproduced in Appendix C.

In his booklet on Australian timber, published in 1900, Mr. James Mann, Assistant to the Professor of Engineering, Melbourne University, thus refers to that memorandum in so far as the tensile strength of Jarrah and Karri is concerned:—

> A circular issued by the Western Australian Public Works Department, as revised to 29th December, 1896, includes eleven tests on Jarrah and thirteen on Karri, tested by the Admiralty in 1894. The ultimate tensile resistance in pounds per square inch is given for Jarrah, 5,000lbs.; for Karri, 7,200lbs. No specimens tested in Australia have reached so low a figure, the lowest being 9,700lbs. per square inch and the highest 20,082lbs. It is difficult, therefore, to see why the West Australian Board of Public Works should adopt 5,000lbs. and 7,200lbs. as ultimate breaking load, clearly admitting that they are equal only to Oregon or Norway pines.

The reason for the figures mentioned, together with those for transverse strength, compression, and detrusion being adopted was that, probably owing to more or less widely differing conditions of selection, seasoning, moisture, etc., such large margins of divergence obtain in the results of various experimenters, that it was considered prudent to keep within the bounds of assured confidence (and consequently low standard of strength) rather than to work to even an average of results.

Thus, not going beyond the two more important factors of tensile and transverse strength, the following comparison will serve to demonstrate that the Railway and Public Works Departments would have been well justified, had they so chosen, in assuming higher values than those provisionally adopted:—

Timber.	Admiralty.	Professor Warren, Sydney University.	Professor Kernot, Melbourne University.	W.A. Railway Department.	Victorian Timber Board.	Average.	Provisionally adopted.
AVERAGE TENSILE STRENGTH IN LBS. PER SQUARE INCH.							
Jarrah	4,830	16,047	9,700	11,235	...	10,453	5,000
Karri	6,730	13,920	20,082	20,735	...	15,367	7,000
Tuart	5,114	...	...	13,600	...	9,357	5,000
AVERAGE TRANSVERSE STRENGTH IN LBS. PER SQUARE INCH.							
Jarrah	2,095	1,994	...	2,380	1,982	2,113	*1,458
Karri	2,559	1,691	...	2,820	2,621	2,423	*1,513
Tuart	2,348	...	...	2,756	...	2,552	1,544

* With reference to these results, the figures of 1,458lbs. and 1,513lbs. for Jarrah and Karri respectively, given in Table III. of Mr. O'Connor's memorandum, must always be remembered to be those for 12in. by 12in. beams, and consequently, according to accepted ratio, some 25 per cent. below results for small test pieces.

During recent years, however, there have been in course of erection entirely new railway workshops for the State, on a large and modern basis, and amongst the leading features of these is a laboratory, fully equipped with the best and most approved appliances for systematic and scientific carrying out of tests of all materials, and now in operation. Hitherto there have not existed, locally, means whereby comprehensive and reliable revision of the information as to strengths of the timbers of the State could be entered upon; but an extensive series of tests is now in progress, the results of which should be authoritative. In order, however, to have confirmatory data, it is being arranged that the leading timbers should be tested also at one of the recognised laboratories in England.

Under these circumstances, the memorandum of 1896 is being allowed to stand good until it can be substantially and reliably revised and corrected in the light of the local and English results referred to.

SLEEPERS OF WESTERN AUSTRALIAN HARDWOODS.

Report by Mr. W. W. Dartnall, M.Inst.C.E., Chief Engineer of Existing Lines, Perth, W.A.

The species of timber chiefly used in Western Australia for sleepers is Jarrah (*Eucalyptus marginata*). The total number used on the railways, including renewals, has been from 4,000,000 to 5,000,000. The gauge of the W.A. Government Railways is 3ft. 6in.

The size of the sleepers was originally 7ft. x 8in. x 4in., with 46¼lb. rails; but the size now obtaining is 7ft. x 9in. x 4½in., with rails weighing 60lbs. to the lineal yard.

Experience has proved Jarrah to be a very durable timber, and although white ants are plentiful in this State, they have not attacked it to any appreciable extent.

In the early history of the railways, sawn sleepers were used. In cases of renewals, hewn sleepers have been substituted, and are preferred, but there is no reason why sawn sleepers should not be of equal quality if cut substantially with the grain. The sleepers are generally cut from green trees at all seasons of the year. In seasoning, the shrinkage causes cracks at the ends, but these do not extend in more than about 9in. Owing, however, to the interlocked nature of the fibres of Jarrah, these seasoning cracks are not considered to be in any way detrimental to the strength or durability of the sleepers.

The presence of a small show of white wood on a sleeper—provided it be not under the seat of the rail—is not a defect; on the contrary, it proves that the sleeper has been obtained from the outer shell of the tree, which, in the case of Jarrah, is the most durable portion, and free from heartwood, which is the most perishable portion of the tree. The specification for sleepers, however, will govern the extent of sapwood allowed. The sapwood is from about half to three-quarters of an inch in thickness.

Sleepers should be well boxed up with ballast to cover them from the heat of the sun.

In regard to the life of Jarrah sleepers, I would point out the fact, that the progress of the State since the vast areas of auriferous country have been discovered necessitated such urgent alterations and improvements to the existing lines of railway that the sleepers have been subjected to great disadvantages in the earlier stages of their history. Especially does this apply to the case of the Eastern Railway, serving the Kalgoorlie Goldfield, situate 386 miles from the sea-board (Fremantle); the lines had to be relaid with heavier rails, and in many cases the light sleepers remained. Extensive alterations to gradients and duplications of lines were made, during which there was a considerable wear and tear and mechanical damage to the sleepers by reason of lifting when regrading, hauling over when duplications were made, redogging when the heavier rails were laid, and increased engine load at higher speeds on light sleepers when the heavier engines were obtained.

The following instance is given of the life of Jarrah sleepers where they have not been disturbed:—A portion of the Great Southern Railway, from Beverley to Cuballing, about 55 miles in length, was laid with about 110,000 8in. x 4in. Jarrah sleepers in the year 1886 or 1887, and the line was purchased by the Government in 1896. Practically none of the sleepers had been renewed when the line was purchased, and since that time the Railway Department has renewed about 4,300, equal to about 3·9 per cent. in 18 years; and the balance is still in the road.

When Jarrah sleepers fail, it is at the seat of the rail and where dogged to hold the rail; 95 per cent. of renewals are necessitated by causes other than decay of the timber. The timber itself will last two or three times the life of the sleepers. The extent to which this is true varies according to the conditions under which it is used.

When condemned for further use in the line, sleepers are used by the Department for railway fencing posts, culverts, loading platforms, floors, and pitching of slopes, etc., or they could be sold at from 6d. to 1s. each, but are more valuable to the Department for the purposes stated.

The sleepers are notched to receive the rail at an inclination inwards of 1 in 20, and the rail is secured with two dogs each ⅝in. square driven at each end of the sleeper into ⅝in. round holes bored to receive them. The dogs remain as long as they will hold the rail to gauge; when they will no longer do this they are withdrawn and the sleeper is redogged. Where there is heavy traffic, the lower flange of the rails wears into the sleepers and reduces their thickness over this area. These are the forces at work which prevent the sleeper lasting as long as the timber will last.

WANDOO (*Eucalyptus redunca*) is also suitable for sleepers. It is very tough and hard to hew. The tests already made have proved satisfactory.

In connection with this report the following data regarding the Railways and the State generally may prove of value:—

The heaviest weight allowed on a single axle is 12 tons for rails 60lb. to the lineal yard and nine tons for rails 45lb. to the lineal yard. The maximum rigid wheel base is 12ft. 9in. and the minimum 6ft. 6in.

The sharpest curves on the main line (excepting the Darling timber line, where curves of radii 4½ to 5 chains exist) are of 8 chains radius. Generally speaking no extra fastenings have been used, but a bracket for the outside of the sharp curves is being designed for use.

The speed of passenger trains varies from 25 to 30 miles per hour, with maximum about 45 miles; and of freight trains from 18 to 25 miles per hour, with maximum about 35 miles.

The average number of daily trains on busy sections, including Up and Down trains, is as follows:—

Fremantle-Perth	108
Perth-Midland Junction	74
Kalgoorlie-Kamballie	70
Brunswick-Collie	14

The number of sleepers to the mile formerly used was 1,980 for 24ft. rails. The number now used is 2,112 for 30ft. rails.

Although this report has more particular reference to sleepers, it may not be out of place to mention the fact that renewals in timber bridges are being effected with Jarrah timber.

SLEEPERS.

GENERAL STANDARD SPECIFICATION.

RECOMMENDED FOR ADOPTION IN CONNECTION WITH FOREIGN ORDERS.

SPECIAL NOTE.—*Unless the Specification agreed upon between the contracting parties is in reasonably close accordance with this standard specification, the Government will not accept the responsibility of inspection.*

1. Sleepers may be cut from either of the following timbers:—

Jarrah	*Eucalyptus Marginata.*
Wandoo (white gum) ...	*Eucalyptus Redunca.*

2. All sleepers shall be cut from well-matured trees grown in hilly districts, and shall be of good quality, sound throughout, and shall comply in every respect with the special conditions hereinafter set out.

3. Sleepers may be either hewn or sawn, and shall be rectangular throughout, with squared ends. Sufficient allowance for shrinkage shall be made to insure that they shall *fully* hold up to the specified dimensions at port of loading and *generally* at port of discharge; except only that not more than 5 per cent. of any lot may consist of sleepers of short width up to $\frac{1}{4}$ of an inch, or short depth up to $\frac{1}{8}$ of an inch, or short length up to 1 inch; and provided always that no sleeper shall exhibit more than one of these deficiencies.

4. All sleepers shall, before being loaded up for shipment, be subject to the special approval of a Government Inspecting Officer; and, if approved, be forthwith branded by him on one end with the Government brand, and on the other end with any special brand required by the purchaser and to be supplied by him.

5. Every facility shall be given for the closest inspection, and all labour in handling and turning over the sleepers during inspection shall be provided by the seller at his cost.

SPECIAL CONDITIONS.

6. No sleeper shall be cut on the quarter.

7. Every sleeper shall be straight and true and out of winding.

8. Every sleeper shall be free from heartwood, dry rot, gum pockets, groups of pinholes, and large or loose knots; but small firm knots not exceeding two (2) inches in diameter may be allowed, provided none such occur within six (6) inches of either rail-seat.

9. Every sleeper shall be free from pronounced suncracks and seasoning cracks any of which run more than six (6) inches into either end.

10. *Sapwood* shall not occur under the seat of either rail, nor in more than 5 per cent. of any lot under inspection, and then only provided it is nowhere more than one half-inch in thickness.

11. A certain amount of *wane* may be allowed; provided always, that it does not occur in more than 5 per cent. of any lot under inspection, and then not within six (6) inches of either rail-seat; and that it does not measure more than one-and-a-half inches on any face, or reduce the normal end sectional area by more than one-eighth.

BRANDING.

12. The Government brands, which will be impressed on one end of each sleeper, are as hereafter given.

13. Any special brand required by the purchaser (and to be supplied by him) may be impressed on the other end.

INSPECTION CHARGES.

14. The charge for Government inspection and branding, in accordance with the terms of this specification, will be ½d. per sleeper, to be defrayed by the purchaser on presentation to him of voucher.

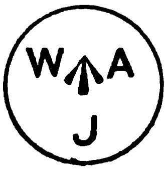
GOVERNMENT INSPECTION OF TIMBER FOR EXPORT.

The inspection of all timber for foreign orders will be undertaken by the State Woods and Forests Department under the following conditions:—

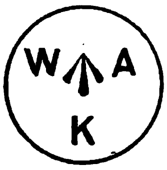
Experienced inspectors are employed to inspect, pass, and brand all timber.

The whole of the timber shall, at the cost of the seller, be turned over at the mills, railway sidings, or in the bush, in the presence of the inspector, before being passed and branded.

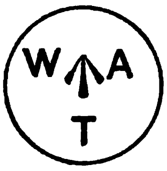
The Government brands, which will be impressed on one end of each sleeper or other timber, are as under:—



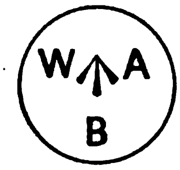
JARRAH.



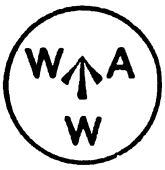
KARRI.



TUART.



BLACKBUTT.



WANDOO.

Any special brand required by the purchaser (and to be supplied by him) may be impressed on the other end.

In the case of sleepers, the Government will not accept the responsibility of inspection unless the specification agreed upon between the contracting parties is in reasonable accordance with the general standard specification for sleepers recommended for adoption in connection with foreign orders.

The charges for Government inspection and branding will be as follows:—

Sawn and hewn sleepers	½d. per sleeper
Do. timber	3d. per 100ft. super.
Round piles	3d. do.

A certificate in the form following is issued covering each shipment of timber.

Note.—As indicative of the general soundness and thoroughness of the inspection, it may be mentioned that no complaints have so far been received in regard to the quality of sleepers supplied to foreign orders, many of which have been very large.

CERTIFICATE OF INSPECTION.

The following is a specimen of the certificate issued by the Government:—

CERTIFICATE OF GOVERNMENT INSPECTION.

Woods and Forests Department,
Perth,.............................., 190 .

This is to certify that the branded timber, described below, shipped by Messrs... .... on board the..................... ...., consigned to the port of.., has been passed by authorised officers of the Department.

Name of Timber.	Brand.	Cross Sectional Dimensions.	Length.	No. of pieces.	Remarks.

Total number of pieces.....................

Issued to Messrs....................................this........................day of.................., 190 .

Signed..
Inspector-General of Forests.

USE OF WESTERN AUSTRALIAN TIMBER FOR CAR AND WAGON CONSTRUCTION.

Report by Mr. E. S. Hume, Chief Mechanical Engineer, State Railways.

The following Western Australian timbers have been used for the above purposes, viz.:—Karri, Tuart, and Blackbutt; the two first-named on the Government Railways, and the third on the privately owned lines.

Of these three, Karri has been used to the greatest extent, there being at present running on the Government lines over 500 wagons in which the underframe and decking, etc., are wholly composed of Karri; and over 2,500 in which the whole of the material is Karri with the exception of the two main underframe longitudinals, which are of mild steel.

This timber is hard, very fibrous, with a straight grain, and finishes well by machine.

When used green the percentage of moisture is high, and timber put into trucks in this condition does not stand nor retain its shape so well as when used in a partly seasoned condition.

Trucks built with Karri frames in 1887, and in continual service since, are still in a sound condition.

The average life of Karri when used in wagon underframes as headstocks and bogie bolsters, etc., is not less than 18 years, nor less than 25 years in the other parts of the framing.

The average weight of Karri is about 60lbs. per cubic foot when fairly well seasoned.

Tuart is a very hard, tough, and sound timber, with a somewhat curly grain, and its average weight when fairly seasoned is 66lbs. It retains its shape and size to a remarkable extent when seasoned, and in no way develops seams or cracks.

It machines well, finishes to a good surface and with keen edges, and is very suitable for either truck or car framing.

Tuart bogie bolsters that were recently cut up and inspected, and that have been in continual service for the past 13 years, were found to be perfectly sound and solid, without longitudinal cracks or seams, and apparently good for a further 20 years' work; whereas American oak bolsters, used in the same service on these wagons, only last from four to eight years, and teak bolsters from eight to twelve years.

Both Karri and Tuart stand well when steamed and bent as roof-sticks, being very easily bent, and many hundreds are in use for this purpose.

Blackbutt has been largely used on the privately-owned lines in the construction of the framing of heavy timber and log trucks; and, under these exceptionally severe conditions, stands many years' service. It is a fairly hard, close, and straight-grained timber, weighing about 60lbs. per cubic foot when seasoned. It shrinks to a certain extent in seasoning, but does not develop cracks or seams.

A very large number of trucks with all-steel underframes were imported some years ago, but the use of timber framing (Karri and Tuart) has been reverted to for all new four-wheeled stock, for the following reasons:—

(*a.*) Four-wheeled trucks with Karri and Tuart frames can be built with the same tare as those with steel frame, and of equal carrying capacity.

(*b.*) The timber-framed trucks possess greater "flexibility," and are, in consequence, less easily derailed than the more rigid steel-framed vehicles.

(*c.*) The first cost in Western Australia is at least 10 per cent. less for the timber frames.

(*d.*) In the event of accidents to frames, the timber frame is more easily and quickly repaired, and the class of labour used, viz., carpenters and assistants, is more readily procurable than the boilermakers who are required to straighten up the steel frames.

(*e.*) The timber-framed trucks built prior to the use of the steel-framed wagons (from 15 to 18 years ago) are still in regular use, and have, on an average, cost less annually for repairs and upkeep than the more recently imported steel-framed vehicles.

STREET PAVING.

Both Jarrah and Karri have been very extensively exported for street paving in various parts of the world, and have been found very satisfactory for this purpose.

It is not proposed here to enter into the wide province of the controversy that has waged as to the respective merits of the two timbers, either as between themselves or in relation to other timbers frequently used for wood-blocking; but it may be stated that these West Australian woods have certainly held, and continue to hold, their own against their many competitors, from the points of view of durability, hygiene, and all-round suitability for vehicle traffic, whether horse or motor. In 1902, a comprehensive pamphlet on Western Australian woods, and their use for street paving, was issued from the London Agency of the State; and in 1903 Millar's Karri and Jarrah Co. printed numerous testimonies and returns relative to the use of Karri and Jarrah for street paving purposes from leading municipal engineers and others. In these two publications may be found much detail and independent evidence as to the merits of Jarrah and Karri for wood-blocking.

GENERAL GUIDE AS TO PORTS OF SHIPMENT OF JARRAH AND KARRI.

While both Jarrah and Karri are shipped from Hamelin, Flinders, and Albany, Karri is not shipped from Fremantle, Rockingham, or Bunbury. Consignments from these latter ports may, therefore, be practically relied upon to be Jarrah only.

INFORMATION CONCERNING TIMBER SHIPPING PORTS.

The ports from which timber is principally shipped for export are as follows:—

Fremantle, Rockingham, Bunbury, Hamelin, Flinders, and Albany.
Shipments are also occasionally made from Busselton.

Full information as to the weather conditions, etc., prevailing at these ports, which are specially indicated on the accompanying map, is given in Appendix D.

FIRMS IN WESTERN AUSTRALIA EXPORTING TIMBER, WITH THE AREAS HELD BY EACH.

	Acres.
1. Millar's Karri & Jarrah Company, Ltd.	813,070
2. Timber Corporation, Greenbushes	54,400
3. Collie Co-operative Society of Timber Hewers.	19,000
4. Western Australian Jarrah Saw Mills Company, Ltd.	5,760

Jarrah is cut by all the above, Karri only by the first company.

FOREST WORKING LAWS.

The forest working laws are comprised in the Timber Regulations gazetted 19th July, 1905, representing recent revision by the Advisory Board dealing with such matters. They are accordingly set out in full in Appendix E, in order to afford complete information as to the conditions under which timber of all kinds may be felled, cut, hewn, or otherwise dealt with in the State.

Appendix A.

Climate of the South-West Timber Districts.

The climate of the coastal districts of the extra-tropical portions of the State is characterised by a winter extending from May to October, and a summer from November to April. In the former season a number of barometric depressions or "lows" pass along the Southern ocean from West to East immediately South of the coast-line, causing heavy rain and, at times, severe North-West and West gales. During this period a belt of high pressure, with comparatively fine weather, prevails in more central latitudes; but as the sun moves Southward the high pressure belt does the same, and during the summer months lies along the Southern coast-line. This, of course, brings finer weather to the timber districts with South to East winds.

During the winter the rain storms are frequently very severe. Unfortunately no automatic records are available from the timber districts; but the pluviograph at the Observatory registered 0·66 inch in 15 minutes on 1901, July 11th, and 0·95 inch in 20 minutes on 1898, May 27th. In the summer time the rain usually consists of light showers, but occasionally a tropical storm travels from the North-West to the South coast, causing partial, but heavy floods.

Moderate temperatures prevail on the coast throughout the year, but inland the nights in winter are rather cold and the days in summer frequently hot. A fair idea of these conditions may be obtained from the following table, giving temperature statistics for three stations:—Collie and Bridgetown, representing inland, and Karridale, coastal conditions.

W. E. COOKE,
Government Astronomer.

SHADE TEMPERATURE.

Monthly means and extremes.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	YEAR.
						Mean maximum.							
Collie ...	85·8	84·6	81·4	72·9	65·3	60·8	58·8	62·2	63·2	67·7	76·1	80·1	71·6
Bridgetown	84·6	84·1	80·7	73·0	66·0	61·6	59·2	62·6	63·7	67·8	75·1	79·3	71·5
Karridale ...	75·5	76·5	75·0	70·8	67·6	62·5	61·2	62·1	63·3	65·7	70·0	73·6	68·6
						Mean minimum.							
Collie ...	53·6	51·2	49·8	43·9	41·1	37·8	36·1	38·2	42·3	44·0	47·8	50·8	44·7
Bridgetown	50·6	48·6	47·0	44·4	41·6	39·4	38·0	39·6	42·8	43·4	46·8	48·6	44·2
Karridale ...	57·0	56·4	54·7	51·7	48·5	47·9	46·4	46·7	48·7	50·1	52·0	54·4	51·2
						Highest ever recorded.							
Collie ...	103·0	100·7	100·8	89·1	77·4	68·0	68·0	75·7	78·7	88·6	99·8	100·2	108·0
Bridgetown	102·5	102·2	100·9	90·0	77·9	69·2	68·3	75·9	79·2	86·0	98·0	100·2	102·5
Karridale ...	99·6	105·5	101·5	92·0	81·1	76·0	70·8	74·4	82·5	85·2	95·0	101·0	105·5
						Lowest ever recorded.							
Collie ...	37·7	37·0	34·7	29·6	29·0	27·6	26·9	29·0	30·8	31·2	35·9	39·5	26·9
Bridgetown	34·1	35·2	31·2	29·5	27·6	26·6	25·9	28·2	32·2	31·2	35·6	36·0	25·9
Karridale ...	42·3	41·1	39·0	36·6	32·5	31·6	30·6	32·5	31·5	36·8	38·0	43·0	30·6

TERRESTRIAL RADIATION.

Mean minimum on the surface of ground.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	YEAR.
Bridgetown	...	...	...	42·2	38·6	37·4	35·3	36·8	38·8	40·8	...	...	38·6
Karridale ...	...	...	...	47·0	42·6	42·7	40·5	42·1	43·6	44·5	...	...	43·3

Lowest ever recorded on surface of ground.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	YEAR.
Bridgetown	...	...	...	26·9	26·5	25·0	21·0	27·0	31·0	29·0	...	...	21·0
Karridale ...	...	...	...	31·4	24·2	23·0	24·5	26·5	25·5	28·5	...	...	23·0

AVERAGE MONTHLY RAINFALL.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	YEAR.
Collie ...	58	20	105	249	421	768	686	611	418	328	88	81	3833
Bridgetown	44	43	105	135	429	584	513	488	375	315	117	131	3277
Karridale ...	82	50	128	245	566	854	774	696	395	334	114	130	4368

Appendix B.

Summary of Timber Exports from Western Australia for the Ten Years 1895 to 1904.

Timber.	1895.		1896.		1897.		1898.		1899.		1900.		1901.		1902.		1903.		1904.		Total.	
	Loads.	Value.	Loads.	Value.	Loads.	Value.	Loads.	Value.	Loads.	Value.	Loads.	Value.	Loads.	Va'ue.	Loads.	Value.	Loads.	Value.	Loads.	Value.	Loads.	Value.
		£		£		£		£		£		£		£		£		£		£		£
Jarrah	25,105	88,146	30,911	116,420	47,866	192,451	52,315	189,741	93,858	375,433	74,462	297,847	101,636	406,545	104,723	418,893	134,969	539,876	146,441	596,272	812,286	3,221,624
Karri	...	...	...	...	...	...	29,407	136,371	44,405	177,622	40,045	160,180	41,375	165,502	20,381	81,525	20,000	80,136	15,000	58,677	210,613	860,013
Tuart	...	...	...	...	...	...	10	50	...	...	1	9	...	...	...	...	...	...	...	...	11	59
White Gum	...	...	...	...	...	...	5	33	7	29	...	...	...	...	...	...	...	...	...	...	12	62
Miscellaneous	...	..	...	...	...	...	...	...	...	114	...	828	...	307	...	115	...	...	...	...	...	1,364
	25,105	88,146	30,911	116,420	47,866	192,451	81,737	326,195	138,270	553,198	114,508	458,864	143,011	572,354	125,104	500,533	154,969	620,012	161,441	654,949	1,022,922	4,083,122

In addition to the above a large quantity of Sandalwood has been exported from the State, chiefly to China and India, amounting in value to the sum of £445,744 during the last ten (10) years.

EXPORTS OF WESTERN AUSTRALIAN TIMBER FOR THE YEAR 1904.

Countries to which exported.	Quantities.	Value.
	Super. feet.	£
TIMBER.		
Dressed—		
New South Wales	2,951	20
New Zealand	6,240	42
	9,191	62
Undressed, in sizes of 12in. x 6in. (or its equivalent) and over—		
New South Wales	3,700	21
Victoria	2,734,088	25,598
South Australia	356,046	3,268
	3,093,834	28,887
New Zealand	140,916	939
United Kingdom	2,943,330	20,282
Belgium	81,016	840
Cape Colony	601,663	4,013
Ceylon	9,852	80
India	920,726	6,140
Lorenzo Marquez	625,272	4,168
Mauritius	28,200	188
Natal	882,187	5,881
Philippine Islands	90,972	607
	9,417,968	72,025
Undressed, in sizes of less than 12in. x 6in. (or its equivalent)—		
New South Wales	169,106	1,132
Victoria	131,112	726
South Australia	5,767,945	38,924
	6,068,163	40,782
New Zealand	3,019,428	20,129
United Kingdom	25,200,417	166,773
Argentine	467,208	3,115
Cape Colony	8,546,368	57,136
Ceylon	2,682,540	17,728
Egypt	3,116,808	20,778
Hong Kong	580,758	3,878
Holland	703,980	4,693
India	21,845,673	145,633
Lorenzo Marquez	6,927,892	46,185
Mauritius	647,928	4,316
Natal	3,809,650	25,396
Philippine Islands	2,033,682	13,558
Singapore	37,500	250
Straits Settlements	947,046	6,314
U.S. of America	948	6
Belgium	17,983	120
	86,653,972	576,790
Logs not sawn, and spars in the rough—		
South Australia	10,776	70
New Zealand	5,340	36
United Kingdom	632,484	4,217
Argentine	135,012	900
	783,612	5,223
Grand Totals ...	96,864,743 (161,441 loads)	654,100*

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* In addition some 117,000 pickets have been exported to New South Wales, Victoria, South Australia, and New Zealand at a value of £849, raising the grand total value to £654,949.

Appendix C.

THE STRENGTH OF WESTERN AUSTRALIAN TIMBERS.

The letters in the various formulæ hereunder represent as follow :—

k = Co-efficient of transverse strength.
b = Breadth of beam in inches.
d = Depth of beam in inches.
s = Span in inches.
w = Breaking weight in lbs.
w′ = Weight in lbs. producing deflection (with elasticity unimpaired).
D = Deflection in inches produced by the weight w′.
E = Modulus of transverse elasticity.

Table I.

WESTERN AUSTRALIAN TIMBERS.

Strength in Tension, Compression, and Detrusion, as given by various Authorities.

Name of Timber.	Results of Tests by	Ultimate resistance in lbs. per sq. in.			No. of Specimens tested.
		Tension.	Compression.	Detrusion.	
Jarrah ...	Admiralty, 1894	5,000	6,900	680	11 specimens in tension, 2 in compression, and 2 in detrusion.
	Victoria Exhibition, 1880...	2,940	7,163		
	Professor Warren, 1890 ...	16,047	6,800	...	4 specimens in tension and 6 in compression. Specimens tested in tension less than ¾in. diameter.
Karri ...	Admiralty, 1894	7,200	6,800	580	13 specimens in tension, 2 in compression, and 2 in detrusion.
	Victoria Exhibition, 1880...	7,070	11,513		
	Professor Warren, 1890 ...	13,920	6,560	...	1 specimen in tension and 4 in compression. Specimen tested in tension less than ¾in. diameter.
Tuart ...	Admiralty, 1894	5,000	9,300	670	7 specimens in tension, 2 in compression, and 2 in detrusion.
Wandoo ...	Admiralty, „	6,500	8,600	580	4 specimens in tension, 2 in compression, and 2 in detrusion
White Gum ...	Admiralty, „	5,600	10,000	760	3 specimens in tension, 2 in compression, and 2 in detrusion.
Flooded Gum	Admiralty, „	4,600	9,800	680	3 specimens in tension, 6 in compression, and 3 in detrusion.

Table II.

WESTERN AUSTRALIAN TIMBERS.

Weight per cubic foot, Transverse Strength, and Transverse Elasticity, as given by various Authorities.

Name of Timber.	Results of Tests by	Weight per cubic ft. Lbs.	Co-efficient of Transverse Strength, from formula $K=\frac{SW}{4bd^2}$ * Lbs.	Modulus of Transverse Elasticity, from formula $E=\frac{W'S^3}{4bd^3D}$ * Lbs.	Number and Size of Specimens tested for Transverse Strength.
Jarrah ...	Admiralty, 1894... ...	51	2,166	1,750,000	11 specimens, 72″ x 2″ x 2″
	Victoria Exhibition, 1880	63	1,800		
	Professor Warren, 1890	62	2,000	1,390,000	6 specimens, 54″ x 6″ x 4″
	Mr. J. A. McDonald, 1896	69	1,472	2,426,659	4 specimens, 25ft. x 12″ x 12″
Karri ...	Admiralty, 1894... ...	59	2,566	2,600,000	13 specimens, 72″ x 2″ x 2″
	Victoria Exhibition, 1880	61	2,264		
	Professor Warren, 1890	60	1,691	1,707,000	3 specimens, 54″ x 6″ x 4″
	Mr. J. A. McDonald, 1896	67	1,316	3,168,355	2 specimens, 25ft. x 12″ x 12″
Tuart ...	Admiralty, 1894... ...	66	2,316	2,228,000	7 specimens, 72″ x 2″ x 2″
	Victoria Exhibition, 1880	73	2,701		
Wandoo ...	Admiralty, 1894... ...	72	2,766	2,566,000	5 specimens, 72″ x 2″ x 2″
White Gum	Admiralty, „	69	2,853	2,500,000	3 specimens, 72″ x 2″ x 2″
Flooded Gum	Admiralty, „	76	1,500	1,300,000	3 specimens, 72″ x 2″ x 2″

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* These formulæ are for the case of a rectangular beam supported at both ends and loaded in the middle, which was the condition under which most of the tests were made, and, when made otherwise, the formulæ adopted were of course adjusted accordingly.

In explanation of the great differences in weight per cubic foot of the various specimens, it may be mentioned that the weight of Australian timber keeps on decreasing until it is thoroughly seasoned.

TABLE III.

WESTERN AUSTRALIAN TIMBERS.

Weight per cubic foot; also ultimate Strength in Tension, Compression, Detrusion, Transverse Strain, and Modulus of Transverse Elasticity, to be adopted by the Western Australian Public Works Department.

The figures herein have been deduced principally from the tests made by the Admiralty Officers at Woolwich, in 1894; and also from those made by Mr. J. A. McDonald, at Fremantle, Western Australia, in 1896, as shown in Tables I. and II. herein:—

Local name of Timber.	Botanical name of Timber.	Weight per cubic ft. Lbs.	Ultimate Resistance in lbs. per square inch.			Co-efficient of Transverse Strength. Lbs.	Modulus of Transverse Elasticity. Lbs.
			Tension.	Compression.	Detrusion.		
Jarrah ...	E. Marginata ...	65	5,000	6,900	680	1,458	2,080,000
Karri	E. Diversicolor ...	63	7,000	6,800	580	1,513	2,890,000
Tuart	E. Gomphocephala ...	67	5,000	9,300	670	1,544	2,300,000
Wandoo ...	E. Redunca	72	6,500	8,600	580	1,844	2,600,000

TABLE IV.

PRINCIPAL FOREIGN TIMBERS USED IN ENGINEERING STRUCTURES IN WESTERN AUSTRALIA.

Weight per cubic foot; also Ultimate Strength in Tension, Compression, Detrusion, Transverse Strain, and Modulus of Transverse Elasticity, to be adopted by the Western Australian Public Works Department as being fair averages of data to hand.

Local name of Timber.	Weight per cubic foot. Lbs.	Ultimate Resistance in lbs. per square inch.		Co-efficient of Transverse Strength. Lbs.	Modulus of Transverse Elasticity. Lbs.
		Tension.	Compression.		
Oak (British)	54	10,000	8,000	1,670	1,200,000
Elm (English)	40	5,500	6,000	1,000	600,000
Beech	40	11,000	8,000	1,670	1,350,000
Teak	49	10,000	9,000	2,170	1,300,000
Oregon Pine	34	5,000	7,000	1,150	1,500,000
Norway Pine	36	6,700	7,000	1,820	1,800,000
Maple (American)	50	10,000	6,800	2,200	1,800,000
Hickory	55	11,000	8,000	2,400	
Kauri (New Zealand)	34	5,000	6,000	1,500	1,253,000
Rimu	37	...	...	1,300	991,000
Totara	35	...	...	1,200	861,000
Ironbark (N.S.W.)	74	18,000	10,000	2,100	2,400,000
Blue Gum (Tasmania)	63	20,000	7,500	1,800	2,038,000
Grey Box (Victoria)	73	22,000	8,000	2,000	2,700,000

Safe Working Stress.—To obtain the safe working stress, the above values for the strength of the timbers under the various stresses must be divided by a factor of safety of 4 for dead loads, and 8 for live loads, or else multiply dead load by 4, and live load by 8.*

In cases of compression strains, Gordon's formula for the strength of long columns must be applied when the ratio of length to least diameter is greater than 12 to 1.

Ultimate Strength.—

To find the ultimate strength of a beam fixed at one end and loaded at the other:—

$$W = \frac{b\,d^2\,K}{S}$$

To find the ultimate strength of a beam fixed at one end and uniformly loaded:—

$$W = \frac{2\,b\,d^2\,K}{S}$$

To find the ultimate strength of a beam supported at both ends and loaded in the centre:—

$$W = \frac{4\,b\,d^2\,K}{S}$$

To find the ultimate strength of a beam supported at both ends and uniformly loaded:—

$$W = \frac{8\,b\,d^2\,K}{S}$$

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* NOTE.—When using the co-efficients for Jarrah and Karri deduced from Mr. McDonald's tests of large-sized beams, the factor of safety may be reduced to 3 for dead loads, and 6 for live loads.

Deflection.—

To find the deflection of a beam fixed at one end and loaded at the other:—

$$D = 4 \frac{S^3 W'}{E b d^3}$$

To find the deflection of a beam fixed at one end and uniformly loaded:—

$$D = \frac{3}{2} \frac{S^3 W'}{E b d^3}$$

To find the deflection of a beam supported at both ends and loaded in the centre:—

$$D = \frac{1}{4} \frac{S^3 W'}{E b d^3}$$

To find the deflection of a beam supported at both ends and uniformly loaded:—

$$D = \frac{5}{32} \frac{S^3 W'}{E b d^3}$$

In order to enable the figures showing the co-efficients of transverse strength, given herein, to be reconciled with similar figures in various books on the strength of timbers, it may be desirable to explain that the value of k, as herein given, represents the ultimate strength of a piece of timber 1in. square, built into a wall and loaded at a distance of 1in. from the face of the wall, *i.e.*, a cantilever whose breadth, depth, and span are each 1in. Or, to put it in another way, the value of k, herein, may be described as applying to the case of beams firmly fixed at one end and loaded at the other, all the dimensions being in inches.

In order, therefore, to reconcile the value of k, as given herein, with the co-efficients given in Trautwine's Pocket Book, and in the Juror's Report of New Zealand Exhibition of 1864, which are for the case of beams supported at both ends and loaded in the middle, and for breadth and depth in inches, but for span in feet, the figures herein must be first divided by 12, and then multiplied by 4, *i.e.*, in fact, divided by 3.

Similarly, again, in the case of the figures given in Mr. Barlow's book on timbers (edition of 1851), although they are based on exactly the same data as the figures herein, and should therefore not require any reconcilement at all, they nevertheless do require reconcilement, by reason of the fact, that, in the calculations of Mr. Barlow's figures the span was assumed to be the whole length of the stick, viz., 7 feet, instead of being what it actually was, viz., 6 feet. Mr. Barlow's figures for transverse strength should therefore be multiplied by 0·86 in order to reconcile them with the figures herein.

The same applies to Mr. Laslett's book on strength of timbers, which follows exactly on Mr. Barlow's lines.

Similarly, again, in order to reconcile the figures given in Professor Warren's book on Australian timbers, the South Kensington Course of Building Construction, and all other books which give the modulus of rupture for the transverse strength, the values of k, as given herein, must be multiplied by 6 in order to reconcile them with the said modulus of rupture.

C. Y. O'CONNOR,
Engineer-in-Chief.

Public Works Office,
Perth, 29th December, 1896.

Appendix D.

INFORMATION CONCERNING TIMBER-SHIPPING PORTS.

FREMANTLE.

The harbour at Fremantle, the principal port of the State, is administered by the Harbour Trust, which issues periodically a pamphlet entitled "Information relative to the Port," from which the following memoranda are compiled:—

Geographical Position of Fremantle.—Fremantle (latitude 32° 03′ S., longitude 115° 45′ E. at Timeball Tower on Arthur Head), situated at the mouth of the Swan River, has always been the principal seaport of Western Australia.

Railway System.—Fremantle is the Western terminus of the railway system of the State. The wharves are in direct communication with the railway system.

Description of Port.—The Port of Fremantle consists of Gage Roads, Owen's Anchorage, Cockburn Sound, and the Inner Harbour. Gage Roads is a large area of water enclosed between a long line of islands and reefs and the mainland. The Roads are about five miles wide by eight miles long, and are open only to the North. Owen's Anchorage and Cockburn Sound lie to the South of Gage Roads. Anchorage in any of these areas is good and safe in all weathers, the bottom being sand.

The Inner Harbour, where practically all the shipping business of the Port is now carried on, is a modern artificial harbour within the estuary of the Swan River, protected by two rubble moles. The harbour proper has a length of about 4,500 feet, and is for the most part 1,400 feet in width. The depth of water in channel and harbour throughout is 30 feet below lowest low water. The total wharfage accommodation already completed inside the harbour is 9,255 lineal feet.

Throughout the nine years since the Inner Harbour was first used for shipping, there has been no accident of any sort to vessels entering or leaving the harbour. Steamers of heavy draught constantly berth at the quays, navigating the entrance channel and harbour under their own steam; the greatest draught thus dealt with so far has been 29 feet 8 inches.

Lighthouses.—The entrance to the port of Fremantle is exceptionally well lighted, there being on Rottnest Island, situated at the entrance, a 1st order revolving light, and a 2nd order fixed white light at Bathurst Point. On rounding Rottnest there is brought into view another 1st order light, exhibited from a grey stone tower on a hill behind Woodman's Point, to the South of the town of Fremantle.

Light Dues.—Light dues payable by vessels discharging or loading cargo less in extent than one-fourth of their net registered tonnage amount to 1d. per ton on their net registered tonnage, which payment covers both the inward and outward trip, instead of the 4d. per ton payable by vessels working cargo in excess of one-fourth of their net register.

Tonnage Dues.—All foreign-going vessels, 3d. per ton inwards and 3d. per ton outwards.

If cargo in or out is in excess of one quarter of net registered tonnage, then net registered tonnage is taken, but if cargo is less than one quarter net registered tonnage, then tonnage of cargo is taken.

Pilotage.—The rates of pilotage are as follow:—

Pilot ground to Gage Roads—

Steamers: 3d. per ton on their net registered tonnage; maximum, £21.
Sailing Vessels: 4d. per ton on their net registered tonnage; maximum, £15.

Rates of Towage for Sailing Vessels.

From sea to and from Gage Roads, 1d. to 3d. per ton, as below:—

	Per ton.	
	s.	d.
Inwards.—Wind North from position S.W. of Rottnest	0	3
„ South „ N. of Rottnest	0	2
„ „ „ Pilot Ground	0	1
„ „ „ off Hall's Bank	0	1
Outwards.—Winds and positions *vice versa* same rates.		
Wind N. to N.E. to position both Rottnest Lights in one	0	2½
Gage Roads to and from River, 6d. ton (then outwards free).		
Ships part loaded, Rockingham, finishing in Swan River—		
River outwards from River to Roads	0	3
River or Gage Roads to Rockingham	0	6
Rockingham to River or Gage Roads *via* Challenger Passage	0	6
Rockingham to Sea *via* Challenger Passage	0	6

Weather Forecasts.—The Meteorological Department of the Observatory has telegraphed to it daily from all the observing stations in Western Australia, and from the principal stations in the other States, readings of barometer, thermometer, conditions of wind, rain, weather, and state of the sea, etc.; and from these a general weather report, a special rainfall report, an isobar map, and a forecast of the probable weather for the next 24 hours is prepared. These are exhibited daily in the Post Offices of Perth and Fremantle, and copies may be obtained by masters of vessels requiring them.

With regard to the ports of Rockingham, Bunbury, Hamelin, Flinders, and Albany, the following memoranda by the Chief Harbour Master for the State (Captain C. J. Irvine) provide all necessary information:—

ROCKINGHAM.

Situation.—On the South extremity of Fremantle Harbour. This port was at one time the principal timber shipping place of the State, and is well protected to seaward by Garden Island and the shoal water off Point Peron. Vessels can lie either in the bay or at the jetty, in all weathers, with perfect safety.

Jetties.—There are two jetties, providing ample accommodation for four vessels, at which they can load at the outer berths to thirty (30) feet; but owing to the Admiralty limit of draught of water through the Challenger Passage being 16 feet 6 inches, vessels are prohibited from loading to a greater depth, consequently vessels so requiring are obliged to finish loading in Gage Road or Fremantle Inner Harbour, which necessitates extra handling and lighterage.

The jetties are connected with the railway system of the State, the company's line crossing the South-Western State line at Mundijong. Water also is laid on to the jetties, and labour is plentiful.

Connections.—Rockingham is connected with the telegraph system of the Commonwealth by means of a telephone line to Beaconsfield Post Office (South Fremantle).

Moorings.—One set of heavy moorings is provided, and is useful for vessels not requiring to make a lengthy stay, and for hauling off from the jetty.

Anchorage.—Good anchorage is found in the vicinity, the holding ground being of the best.

Lights.—The Fremantle and Rottnest lights meet all requirements.

Pilotage.—Pilots are at all times available from the Fremantle Harbour Trust. Charges are 2d. per ton net register; maximum, £8.

Tug Boats.—The Steam Tug Boats at Fremantle are at all times available. Rates of towage by agreement.

Harbour Dues.—Light and tonnage dues are included in Fremantle Port charges.

BUNBURY.

Situation.—On the South-West extremity of Koombana Bay, lat. 33° 19′ South, long. 115° 39′ East. Bunbury is the principal timber shipping port of the State, and is protected by a substantially-built stone breakwater about 3,200ft. long, running in a Northerly direction from Casuarina Point. A further length of 800ft. is authorised and about to be undertaken, which will have the effect of affording considerably improved protection to ships.

Jetty.—The jetty is about 4,000ft. in length, with a depth of 23ft. of water at the outer end, and an extension of 300ft. is now in hand. There are berths for nine vessels, which can lie alongside all through the year; but it may be necessary in bad weather, especially in the winter months with Northerly gales, to let go and drop off to anchor.

The jetty is connected with the railway system of the State, by which means the timber is placed alongside of vessels. Donkey engines and cranes to facilitate loading are provided, and labour is plentiful. Water is laid on to the jetty.

Moorings.—Moorings are provided off each berth at the jetty to ease the strain on same, and wear and tear of ships. Two sets of heavy moorings are provided in the stream, where vessels can safely lie in any weather and load to a draft of 24 feet.

Lights.—On the summit of the hill, 400 yards within Casuarina Point, a dioptric 3rd order light (electric) is exhibited from an open braced steel tower at an elevation of 122 feet, and visible 17 miles. At the end of the breakwater a fixed green light is shown, visible seven miles. There are also two fixed red lights on the jetty, which, in line, lead clear of the breakwater.

Anchorage.—The best anchorage is in 4½ fathoms sand and mud bottom, with the lighthouse bearings S.W. by W. ¾ W.

Harbour Officials.—A harbour-master and a pilot are provided, who, by means of a pilot cutter, board all vessels making the port.

Pilotage.—Pilotage charges are according to drafts. Maximum, £11; minimum, £2 10s.

Tug Boats.—A steam tug is always available. Rates of towage by agreement.

Light Dues.—Light dues are at the rate of twopence (2d.) per ton inwards, and twopence (2d.) per ton outwards.

Tonnage Dues.—Tonnage dues are charged at the rate of threepence (3d.) per ton inwards and threepence (3d.) per ton outwards, on vessels' registered tonnage, provided amount of cargo landed or shipped exceeds one quarter of the vessel's registered tonnage; otherwise the charge is threepence (3d.) per ton on goods actually handled.

The Town of Bunbury has a population of about 3,000, and the District of about 10,000. It is the principal port for export of Jarrah, shipments having gone up as per following table:—

1898	£12,000
1900	£105,500
1902	£218,300
1903	£446,000
1905	£560,000

BUSSELTON.

Situation.—At the head or Southernmost part of Geographe Bay, which lies between Casuarina Point and Cape Naturaliste, 33 miles apart. The climate is cool, and the rainfall regular and abundant.

Jetty.—A jetty extends in a N. by W. half W. direction for a distance of 4,032ft., including a head which provides ample accommodation for two large vessels with a draught up to 18ft. The jetty is fitted with spring fender piles, and ships can lie comfortably here in any but exceptionally bad weather. Vessels can communicate with the shore by the Commercial Code of Signals.

The jetty is connected with the railway and telegraph system of the State, and timber is put alongside vessels in rail trucks.

Supplies.—Supplies of provisions can be obtained here in unlimited quantities.

Lights.—From a white tower, near the inner end of the jetty, at an elevation of 63ft. above the sea, a fixed white light (fourth order dioptric) is exhibited, visible at a distance of about 15 miles. A small fixed red light is shown from the outer end of the jetty. The recently-installed first order light at Cape Naturaliste is also of great assistance in making this port.

Anchorage.—Vessels may find fair anchorage in 4½ to 5 fathoms, with Busselton Lighthouse bearing S.E. ¾ S., distant 1½ miles.

Although Geographe Bay is open to the North-West, remarkably smooth water is experienced in comparison with the strength of the wind during gales from that quarter. The Westerly swell was observed to diminish quickly Eastward to a line joining Capes Naturaliste and Bouvard, especially Southward of a line joining Cape Naturaliste and Minninup Sandpatch. A thick coating of seaweed was seen growing upon the bottom in depths of 15 fathoms and less water, which probably helps to break up the swell.

Shoals.—Detached gravel banks, with from 2¾ to 3 fathoms on them, and 4 to 5 fathoms close around, lie N.W. by W., distant 2¼ miles from Busselton Lighthouse.

Light and Tonnage Dues.—Light and tonnage dues are the same as those charged at Bunbury.

HAMELIN.

Situation.—Hamelin, 40 miles South of Cape Naturaliste, lies between North Point and White Cliff Point, and is protected from the Southward and Westward by Hamelin Island and the reefs extending from it. This bay affords good shelter during the summer months, or with winds Southward of West; but is quite open between North and West, from which quarter severe gales are experienced during the winter months—viz., May to November. Boranup Sandpatch, about the middle of the bay, is very conspicuous, and is a useful landmark when making this port, being visible in clear weather for over 20 miles.

Inner Harbour.—This harbour lies immediately Southward of Peak Islet, with depth of 4 to 4½ fathoms. Although of small extent, it is a secure haven for vessels of light draught, especially during the summer months. The channel into the Inner Harbour is usually buoyed, but the services of a local pilot are necessary.

Jetty.—A jetty, 1,687 feet in length, including a head of 281 feet by 50 feet, extends from the Eastern shore of the Inner Harbour. Vessels of 16 feet draught lie alongside, but must haul off to moorings should the weather necessitate it. The jetty is connected with the Timber Company's railway system to Karridale and the mills, and the timber is loaded direct from railway trucks. There are steam donkey engines to facilitate loading, and fresh water is laid on. Labour also is abundant. The jetty is connected by telephone with Karridale, which place is in telegraphic communication with the rest of the Commonwealth.

FLINDERS BAY.

Situation.—Situated five miles East of Cape Leeuwin, Flinders Bay is protected from Northerly or Westerly winds by the mainland, and from Southerly winds by Alouran Islet and reefs. It affords a safe and commodious anchorage for vessels of deep draught from the beginning of May until the end of October; but is exposed to the South-East, from which quarter strong gales sometimes blow during the summer, sending in a heavy ground swell.

Jetty.—The jetty extends in an Easterly and South-Easterly direction, and is 1,242 feet long, including a head of 644 feet in length with breadth of 53 feet. The depth of water at outer end is 34 feet and at inner end 24 feet.

The spring or fender piles render lying alongside easy, even in rough weather. Lines of rails are laid on the jetty, and the timber is put alongside vessels on rail trucks. Permanent head, breast, and quarter moorings are laid down, and springs for stern and breast moorings to wharf. Fresh water is laid on to the jetty, and donkey engines are provided to facilitate loading. The jetty is in telephonic communication with Karridale, a distance of 11 miles.

Anchorage.—The best anchorage is in eight fathoms of water, with the jetty bearing W. ¼ N. and the entrance of the Blackwood River N.W. by N.

Pilotage.—The services of a local pilot are available for vessels working into the bay.

Charges.—At both Flinders Bay and Hamelin Jetty a charge of 6d. per register ton covers berthing dues, use of springs, moorings, etc.

Light and Tonnage Dues.—Light and tonnage dues at this port and Hamelin are the same as those charged at Bunbury.

ALBANY.

Situation.—On the North shore of Princess Royal Harbour, 338 miles from Perth by rail. Albany is one of the finest natural harbours of Australia, and is easy of approach, King George's Sound affording a secure anchorage in all weathers, and is a leading port of call for steamers to and from Europe and South Africa as a coaling station and for export of timber. Princess Royal Harbour Channel has been dredged to at least 30 feet L.W. The channel is defined by four pile beacons, showing two red lights on North side and two white lights on South side.

Jetties.—There are two jetties. The outer one is able to accommodate vessels up to 29 feet draught. The inner or Town Jetty has four berths for vessels of lighter draught. Both jetties are connected by rail to the railway system of the State, and loading and discharging are direct into the rail trucks. The jetties are well supplied with donkey engines and steam cranes to facilitate loading. Water is laid on. Labour is also plentiful.

Harbour Officials.—There is a harbour master and pilot station, and a pilot boards all vessels in the Sound.

Tug Boats.—Tug boats are always obtainable at rates fixed by agreement.

Lights.—From a new granite lighthouse on Breaksea Island, at the entrance to King George's Sound, a fixed white light is shown, visible at a distance of 25 miles. From Point King there is also shown a fixed white light, visible at a distance of 12 miles; and from the town jetty there are shown two fixed red lights, which, when kept in a line, lead up to the jetty.

Charges.—Pilotage according to draught. Maximum, £6 6s.; minimum, £2. Light and tonnage dues are the same as at Bunbury.

Appendix E.

FOREST WORKING LAWS.

[*Extract from "Government Gazette" of 29th July, 1905.*]

TIMBER REGULATIONS.

Department of Lands and Surveys,
Perth, 19th July, 1905.

IT is hereby notified, for general information, that His Excellency the Governor in Executive Council has been pleased to repeal the Timber Regulations made under Part XI. of "The Land Act, 1898," on the 18th day of June, 1902, and published in *Government Gazette* on the 27th day of June, 1902, and to make the following Regulations under "The Land Act, 1898" and "The Land Act Amendment Act, 1904."

R. CECIL CLIFTON,
Under Secretary for Lands.

LICENSES.

Timber Licenses.

1. Subject to the existing rights of lessees and licensees under the Land Act and its amendments (hereinafter referred to as "the Act") no person shall get, fell, cut, and remove timber on or from any State forest, timber reserve, or Crown land, unless he holds a timber cutter's license or a timber cutter and hewer's license, issued under these regulations.

2. Applications for a timber cutter's license or a timber cutter and hewer's license may be made at the Forestry Department, in Perth, or to any officer of the Department duly authorised to issue licenses.

3. If the application is approved, a license will be issued in the form No. 1 or No. 2 in the Schedule as the case may be.

4. Licenses will be issued for one month or any number of months not exceeding twelve, and the fee for every license shall be 2s. 6d. a month.

5. Every license shall have effect from a date to be specified therein, and shall specify the area over which it may be exercised, and, unless the license is limited to carting and removing timber, the registered brand of the licensee.

6. Every licensee shall produce his license to any officer of the Forestry Department on demand.

7. A license shall only be available by the licensee named therein, and shall not be transferable except by the special permission of the Inspector General of Forests, or an officer of the Forestry Department appointed to issue licenses.

8. Every licensee being the holder of a timber-cutter's license may, subject to the Act and regulations, fell and remove timber on and from the locality specified in his license, but he shall not hew or cut up timber felled under such license.

9. Every licensee being the holder of a timber cutter and hewer's license may, subject to the Act and regulations, fell and remove timber on and from the area specified in his license, and may hew or cut up any felled timber; but no such licensee shall be entitled to claim at any one time more than three trees felled but not hewn or cut up.

10. No licensee shall fell or remove any tree under standard size, as prescribed by these or any other regulations made in lieu thereof in force for the time being, or any tree which shall have been marked by a forest ranger to signify that it is not to be felled, without the special permission of the Inspector General of Forests.

11. Every licensee, unless his license is limited to the carting and removing of timber, shall provide himself with a distinctive branding iron to be approved by and registered with the officer by whom his license is issued. All brands must be bold and distinct and not less than one inch in length.

12. Every licensee shall distinctly brand with his registered brand the stump of every tree felled by him immediately after the tree is felled, and the head before any timber is removed.

13. A timber cutter's license shall be held by every person engaged in carting or removing timber, and it shall not be lawful for any person to engage in carting or removing timber in any State forest or timber reserve or in the area of any saw-milling permit without such license; but the holder of a license restricted to carting and removing timber will not be required to have a registered brand.

14. Every licensee shall pay royalties in accordance with the scale prescribed by these regulations or any other regulations made in lieu thereof in force for the time being, except in the case of timber cutters employed solely in felling, carting, or removing timber within or from the area of a saw-milling permit for the holder thereof.

Other Licenses.

15. A woodcutter's (firewood) and charcoal burner's license may be issued in the form No. 3 in the Schedule for one month or any number of months, at a fee of one shilling per month per man, and such license shall entitle the holder to cut and remove on and from the locality to be therein specified, for fuel or charcoal burning, such green timber as may be authorised by a forest ranger or other officer of the Department, and any dead timber not worked to a marketable size and shape. A similar license must be obtained by every person engaged only in removing the wood dealt with under a woodcutter's and charcoal burner's license.

16. A sandalwood license may be issued in the form No. 3 in the Schedule for one month or any number of months, at a fee of five shillings per month per man, and shall authorise the licensee to fell, cut, and remove sandalwood on and from the locality to be therein specified.

Sandalwood shall only be cut when fifteen inches at least in circumference three feet from the ground.

A similar license must be obtained by every person engaged only in removing the sandalwood dealt with under a sandalwood license.

17. A wattle bark license may be issued in the form No. 3 in the Schedule for one month or any number of months, from August to January inclusive in any year, and shall authorise the holder to strip and remove the wattle bark on and from the locality to be therein specified.

The fee payable for a wattle bark license shall be five shillings per month per man.

A similar license must be obtained by every person engaged in removing the bark dealt with under a wattle bark license.

18. A bark license may be issued in the form No. 3 in the Schedule for one month or any number of months, at a fee of five shillings per month per man, and shall authorise the licensee to strip and remove bark or to remove the gum from any trees, other than the wattle, the bark or gum of which contains tannic acid, on and from the locality to be therein specified, and the Minister may insert therein such other terms and conditions as he may think fit.

A similar license must be obtained by any person engaged only in removing the bark and gum dealt with under such license.

SAW-MILLING PERMITS.

19. Every application for a saw-milling permit shall be made in the form No. 4 in the Schedule and shall be delivered or sent by post to the Inspector General of Forests, at his office in Perth, accompanied by a deposit of £20.

If the application is approved, the deposit will be retained until the mill is erected, when it will be returned to the applicant; but if the application is refused the deposit will be returned to the applicant forthwith.

On the approval by the Governor of the application, a permit in the form of No. 5 in the Schedule will be granted to the applicant for a term not exceeding ten years, to date from the first day of the then current quarter.

The boundaries of the area over which the right of cutting timber is conferred by a permit shall be surveyed at the expense of the applicant, in accordance with the scale of fees prescribed by the regulations under "The Land Act, 1898."

A saw-milling permit shall entitle the holder, subject to the Act and the regulations in force for the time being, to the sole and exclusive right to cut and remove timber on and from an area described in such permit, and proportional to the horse-power of the mill proposed to be erected on the basis of the provision of ten years' cutting. But the permit holder, and every person employed by him in felling, carting, or removing timber, shall hold a timber cutter's license issued under these regulations.

20. The holder of a saw-milling permit shall, within six months from the date of approval of his permit, erect within the area to which the permit relates, or on such other site as the Inspector General of Forests may approve, a fully equipped saw-milling plant of the capacity provided for in his application, and shall thereafter maintain such plant in working order.

21. Within six months of the approval of the permit the holder shall proceed with the felling and removal of the timber in accordance with the Act and regulations.

22. No saw-milling permit holder shall, by himself or any licensed timber cutter acting for him, fell or remove any tree under standard size as prescribed by these regulations or any other regulations in lieu thereof in force for the time being, or any tree marked by a forest ranger to signify that it is not to be felled, without the special permission of the Inspector General of Forests.

23. Every holder of a saw-milling permit shall pay, for all timber felled and removed on and from the area to which his permit relates, the royalties prescribed by these regulations or any other regulations made in lieu thereof in force for the time being, and the timber cutter's license fee of 2s. 6d. a month for every man employed in felling and hauling timber within such area.

24. Every permit holder shall from time to time confine his operations to certain defined sections of the area, marked under his directions by an officer of the Forestry Department, and not exceeding at any one time such area as is sufficient to supply the mill with two years' cutting. At the expiration of each period of two years the sections as denuded of timber shall be closed from cutting, and reserved with the object of encouraging the preservation and nurture of young timber.

25. The holder of a saw-milling permit shall, on the first day of every calendar month, furnish the Inspector General of Forests with a return verified by statutory declaration, showing the number of logs felled, the measurements of same in the round, and their cubic contents, and the total output of the mill during the last preceding month.

26. No permit holder shall fell in the bush at any time more than one month's supply of logs in advance of the requirements of the mill.

27. The Minister may grant to a permit holder authority to hold an area not exceeding 20 acres on a mill site, during the currency of his permit, at a rent of £1 per annum. Application for such site, defining the position thereof, and accompanied by the first year's rent, shall be forwarded to the Inspector General of Forests in Perth.

28. The Inspector General of Forests or any officer of the Forestry Department may, in the performance of his duties under the Act and the regulations, enter upon any land the subject of a saw-milling permit, and into any sawmill or other building, and inspect any machinery or timber, and all books containing any entries relating to the timber cut or procured under these regulations, which the permit holder shall produce for inspection on demand.

29. In the event of the permit holder failing to maintain his estimated output, as set forth in his application, he shall, notwithstanding, be required to pay at least 60 per cent. of the royalty computed on the amount stipulated in his original estimate, and further, if, in the opinion of the Inspector General of Forests, he fails to maintain his estimated output for what the Inspector General in his discretion considers an unreasonable period, the Minister may reduce the area of such permit proportionately.

30. All timber felled, cut, or sawn, and all buildings erected by, and all the effects of the holder of a permit, not removed from the area within 90 days from the expiration of the permit, shall become the property of the Crown, and may be taken possession of and removed by an officer of the Department or other person authorised by the Minister.

31. The Minister may from time to time set apart any portion of the area over which the sole right of cutting timber is granted by any saw-milling permit, for occupation by workmen and others employed in connection with such permit, or other persons supplying or ministering to the wants of the workmen. Such persons so desirous may obtain a "Residence Permit" or "Business Permit" which will be granted per annum or per month, at the rate of one shilling per month.

32. Should it appear to the Inspector General, by personal inspection or the report of any officer of the Forestry Department, that the holder of a permit is causing unnecessary or wanton destruction of timber, the Inspector General may notify the permit holder to desist from such destruction, and if such destruction is continued it shall be deemed to be a breach of these regulations.

33. The holder of a saw-milling permit shall not cut or remove timber from any freehold or leasehold property while he is operating upon the land held under permit, without the permission, in writing, of the Inspector General of Forests.

34. The rights conferred upon a permit holder by the Act and these regulations shall not affect the right of the Inspector General, or any person claiming under him, to occupy or use the land therein comprised for any purpose consistently with the rights conferred by the permit.

35. Should any royalties or fees payable under a permit or any part thereof be in arrear for 14 days after the due date, whether payment shall have been demanded or not, the Inspector General of Forests, or any officer acting under him in his behalf, may enter and prohibit the felling, sawing, and removing of timber, and may seize all timber felled, and any machinery, horses, plant, or other effects, the property of the permit holder, that may be found upon the land comprised in the permit.

STANDARD SIZES.

36. The standard sizes at which the undermentioned trees may be cut within the South-West Division, South of a line due East from Dongara, at three feet from the ground, with the bark on, are respectively as follows :—

Jarrah	90 inches in circumference.
Karri	108 " "
Tuart	72 " "
Blackbutt	90 " "
Wandoo	48 " "
Morell	48 " "
Yate Gum	36 " "
Sandalwood...	15 " "

ROYALTIES.

37. Timber felled or obtained under "License" or "Permit" shall, unless otherwise provided for, be subject to payment of the following royalties:—

Standard Timber.

Jarrah, Karri, Blackbutt, and Red Gum.

By the log, measured in the round	1s. per load 50 cubic feet.
Hewn timber	2s. 6d. per load (squared).
Split posts and rails for ordinary fencing purposes	2s. 6d. per 100
Split palings	6d. per 100
Split shingles	1s. per 1,000
Split laths (plasterers')	1s. per 1,000

Wandoo and Yate Gum.

By the log, measured in the round	2s. per load 50 cubic feet.
Hewn timber	4s. per load (squared).

Split timber, poles and piles, same scale as jarrah, karri, etc.

Tuart.

By the log, measured in the round	5s. per load 50 cubic feet.
Hewn timber	10s. per load of 50 cubic feet (squared).

Split timber, poles and piles, same scale as jarrah, karri, etc.

Other Hardwoods.

Same scale as Jarrah.

Timber under " standard size " growing upon any Crown land, timber reserve, sawmilling permit area, timber concessions or timber leases, and cut by special permission under these regulations for poles, piles, or baulks, shall be paid in accordance with the following scale :—

	Per lineal foot.	
	s.	d.
Poles up to 3in. diameter at crown, up to and including 30ft. lengths	0	0½
Do. do. do. over 30ft.	0	1
Poles up to 9in. diameter at crown, up to and including 30ft. lengths ...	0	1½
Do. do. do. over 30ft. to 50ft. lengths	0	3
Poles up to 9in. diameter at crown, over 50ft. and up lengths	0	4
Piles up to 12in. diameter at crown, up to and including 30ft. lengths ...	0	2
Do. do. do. over 30ft. to 50ft. lengths	0	4
Do. do. do. over 50ft. and up lengths	0	6
Piles over 12in. diameter at crown, up to and including 30ft. lengths ...	0	3
Do. do. do. over 30ft. to 50ft. lengths	0	6
Do. do. do. over 50ft. to 60ft. lengths	0	8
Do. do. do. over 60ft lengths	0	10

Provided that timber not included in the foregoing scale shall be charged for at the rates proportionate to the general scale of charges, and provided further, that the Inspector General may, where small quantities of timber are required by settlers for *bona fide* use and not for sale, authorise the removal thereof from Crown lands without payment.

No royalty to be charged for firewood, charcoal, sandalwood, wattle bark, or bark.

38. All royalties shall be paid in full before the timber is removed from where it is felled, unless special arrangements are made with the Inspector General of Forests for payment for large and continuous purchases by approved contractors or purchasers at intervals not exceeding fourteen days.

39. Returns of royalties due shall be delivered or forwarded by post or otherwise by the ranger or other officer of the Forestry Department to the permit holder, as far as practicable, at the expiration of every month, and the permit holder shall pay to such officer the amount due within seven days after the date of the return, or within such extended time as may be allowed by the Minister, and no alleged inaccuracy in the return shall be an excuse for delay in such payment beyond the prescribed time; but any proved inaccuracy shall be taken into consideration in any subsequent account, or a refund may be made of any overcharge proved to the satisfaction of the Minister.

GENERAL.

40. No timber shall be removed from where it is felled without the consent, in writing, of an officer of the Forestry Department until the royalty is paid, unless such timber is removed to a mill or depôt approved by such officer, and subject to such condition for the production and inspection on demand of log or record books as such officer may think fit to impose.

41. With the approval, in writing, of the Minister, timber subject to royalty may be removed to and stored for a specified time in an authorised depôt, if such timber is marked with a distinctive brand registered with an officer of the Forestry Department; but such timber shall at all times be open to inspection by any officer of the Forestry Department, who shall have power to seize such timber should it be removed, or detain it should he have reason to suspect there is an intention to remove it from the depôt before payment of royalty, or in case of any breach by the permit holder of these regulations with respect to such timber.

42. Upon payment being satisfactorily arranged for, an officer of the Forestry Department shall inspect the timber felled, or felled and hewn, and brand all such timber as he may consider suitable for market purposes, and such brand shall be deemed a certificate from the Forestry Department that the timber is passed as of first-class quality and true to name. If any timber on inspection does not come up to the required standard it shall be branded with a distinctive brand to indicate that such timber is not deemed to be of first-class quality.

43. If required so to do, such officer may also give a certificate that the timber inspected, in addition to being of first-class quality and true to name, is up to size in accordance with the specification; but no such certificate shall be deemed a guarantee, nor shall the Government be responsible for any error or misstatement therein.

44. All unbranded logs, or logs branded with an unregistered brand or mark, may be seized by any officer of the Foresty Department, and shall be forfeited to the Crown.

45. Should it appear to the Inspector General of Forests, or any officer of the Forestry Department, that a licensee or permit holder is causing unnecessary or wanton destruction of growing timber, or is not utilising timber felled to the best advantage, the Inspector General or such officer, in addition to requiring payment by the licensee or permit holder of one shilling per load for such logs felled, may notify the licensee or permit holder to desist from so doing; and if the licensee or permit holder thereafter continues so to do he shall be guilty of a breach of these regulations.

46. No tree shall be felled so as to obstruct any railway, tramway, road, track, or watercourse, and if any tree is felled in a manner contrary to this regulation, in addition to the penalty thereby incurred for a breach of this regulation, any officer of the Forestry Department may cause the obstruction to be removed at the cost of the person offending against the regulation, and the same shall be recoverable from such person in any court of competent jurisdiction.

47. It shall be unlawful for any licensee or other person to strip the bark from any standing tree, or to fell any tree for the sole purpose of obtaining the bark.

48. The cutting or removal of Kurrajong, Quandong, Red-flowering Gum, and Christmas trees of every kind or size is absolutely prohibited throughout the State.

49. Any officer of the Forestry Department may seize and dispose of any timber unlawfully cut or removed contrary to these regulations or any regulations made in lieu thereof in force for the time being.

50. Any person who, contrary to these regulations, fells, cuts, hews, carries, or removes timber without a license, or otherwise commits a breach of, or fails to observe these regulations or any of them, shall for every offence be liable, on conviction, to a penalty not exceeding £100.

FORM No. 1.

WESTERN AUSTRALIA.

Timber Cutter's License.

No. District

THIS is to certify that , of
is hereby licensed for calendar month from this date to cut and remove timber on and from the locality hereunder specified, under and subject to the provisions of "The Land Act, 1898," and "The Land Act Amendment Act, 1904," and the regulations thereunder in force for the time being.

LOCALITY.

Dated the day of , 190 .

Fee paid

Inspector General of Forests.

FORM No. 2.

WESTERN AUSTRALIA.

Timber Cutter's and Hewer's Lincense.

No. District

THIS is to certify that , of
is hereby licensed for calendar month from this date to cut and remove timber on and from the locality hereunder specified and to hew and cut up any felled timber, under and subject to the provisions of "The Land Act, 1898," and "The Land Act Amendment Act, 1904," and the regulations thereunder in force for the time being.

LOCALITY.

Dated the day of 190 .

Fee paid

Inspector General of Forests.

FORM No. 3.

WESTERN AUSTRALIA.

Woodcutter's (firewood) [or *sandalwood* or *wattle bark* or *bark*] *License.*

No. District

THIS is to certify that , of ,
is hereby licensed for calendar month from this date to [*insert privilege conferred*] on and from the locality hereunder specified, under and subject to the provisions of "The Land Act, 1898," and "The Land Act Amendment Act, 1904," and the regulations thereunder in force for the time being.

LOCALITY.

Dated the day of , 190 .

Fee paid

Inspector General of Forests.

FORM No. 4.

THE LAND ACT, 1898, AND THE LAND ACT AMENDMENT ACT, 1904.

Application for Sawmilling Permit.

No. Division
Plan District

To the Inspector General of Forests.

Under and subject to the provisions of "The Land Act, 1898," and "The Land Act Amendment Act, 1904," and the regulations thereunder in force for the time being, I hereby apply for a sawmilling permit to be exercised over the area described in the schedule hereto for the term of ten years from the day of 190 .

I propose to erect [*state particulars as to mill, tramways, daily estimated output, etc.*].

I deposit herewith the sum of twenty pounds in accordance with the said regulations.

SCHEDULE.

Dated, etc.

FORM No. 5.

THE LAND ACT, 1898, AND THE LAND ACT AMENDMENT ACT, 1904.

Sawmilling Permit.

No. Division
Plan District

HIS Excellency the Governor, with the advice and consent of the Executive Council, and in exercise of the power conferred by Section 11 of "The Land Act Amendment Act, 1904," hereby grants to A.B., of the sole right of cutting timber over the area described in the schedule hereto.

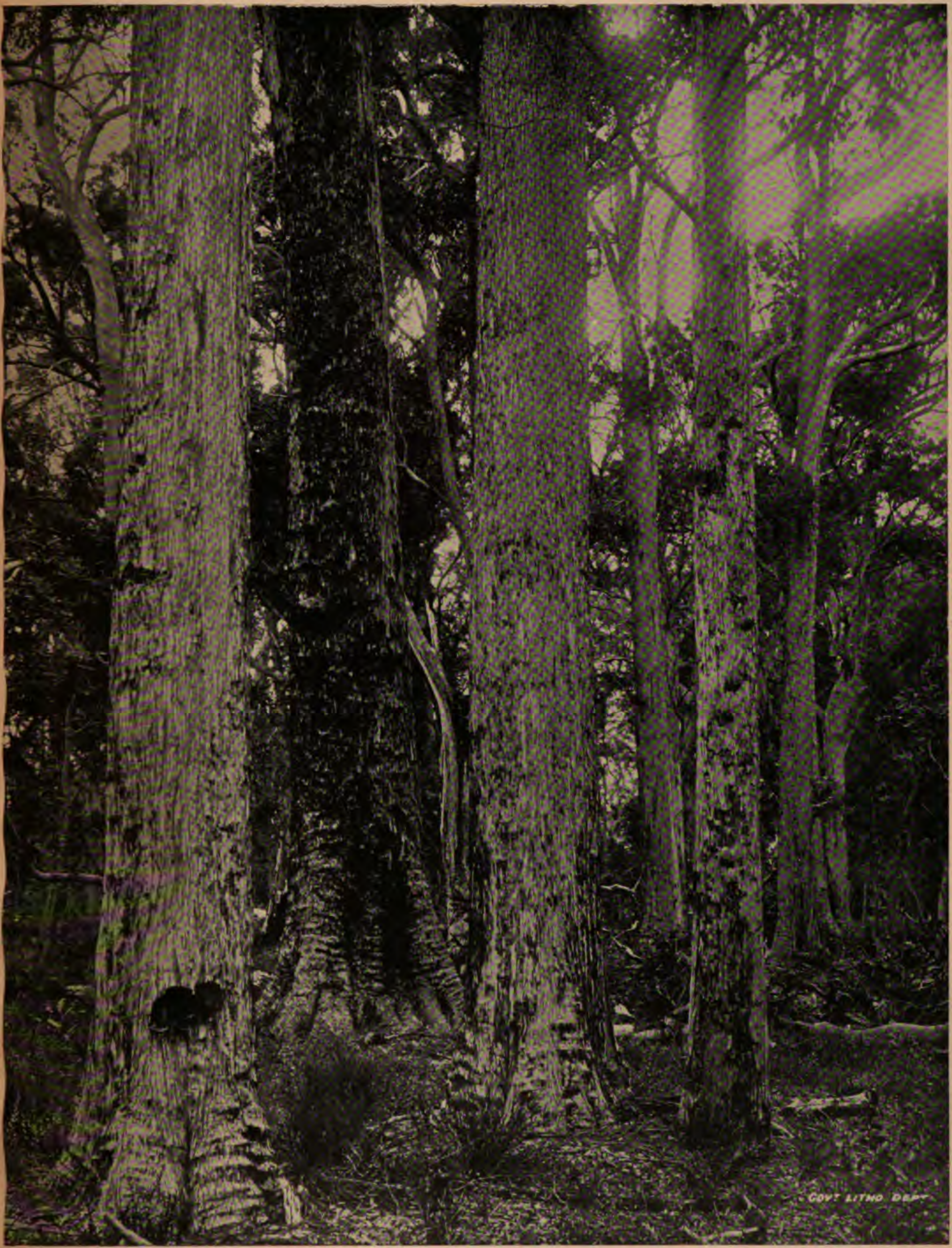
This permit shall continue in force for ten years from the day of , 190 , unless forfeited in the meantime, and is granted subject to the provisions of "The Land Act, 1898," and "The Land Act Amendment Act, 1904," applicable thereto, and to the regulations thereunder in force for the time being, and to the payment of the prescribed license fees and royalties, and also to the following conditions:—[*Here state the special conditions as to erection of mill, construction of tramways, etc.*].

This permit shall not be transferred, without the permission, in writing, of the Minister for Lands first obtained.

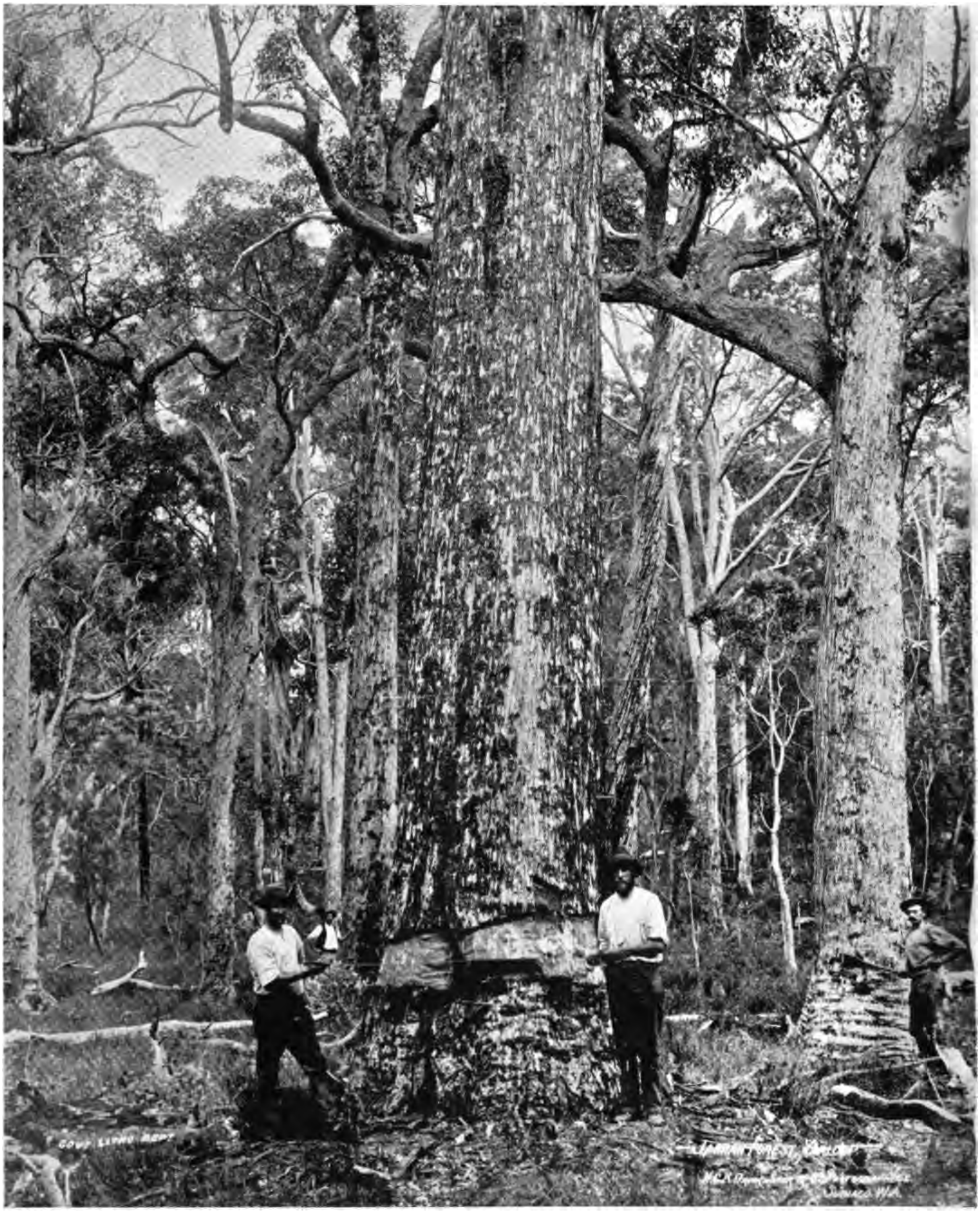
THE SCHEDULE.

All that area of land situated within the State Forest [*or as the case may be*], containing acres and bounded , as more particularly delineated and described in the plan hereunto annexed.

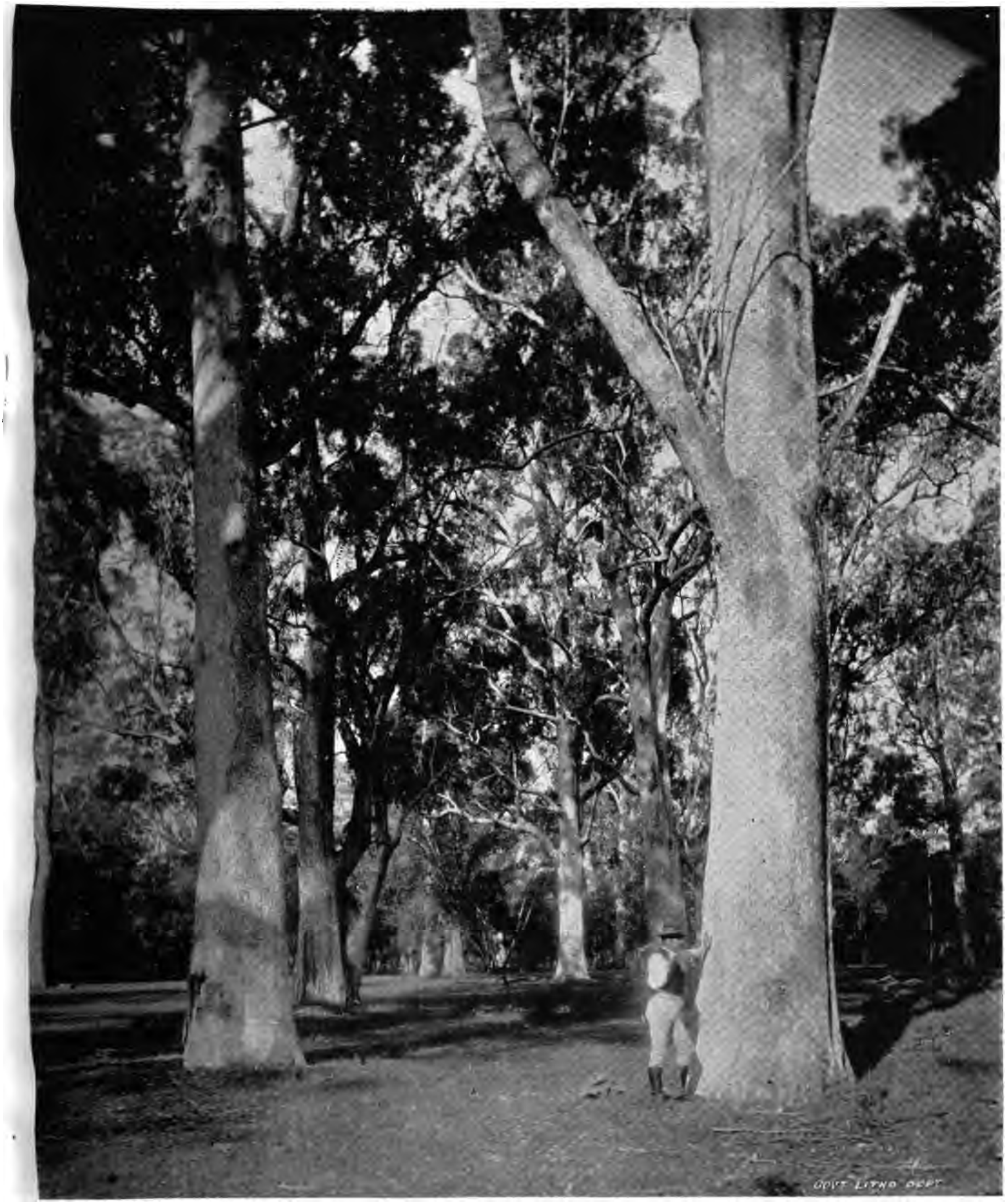
By Authority: A. CURTIS, Acting Government Printer Perth.



View of Jarrah Forest.

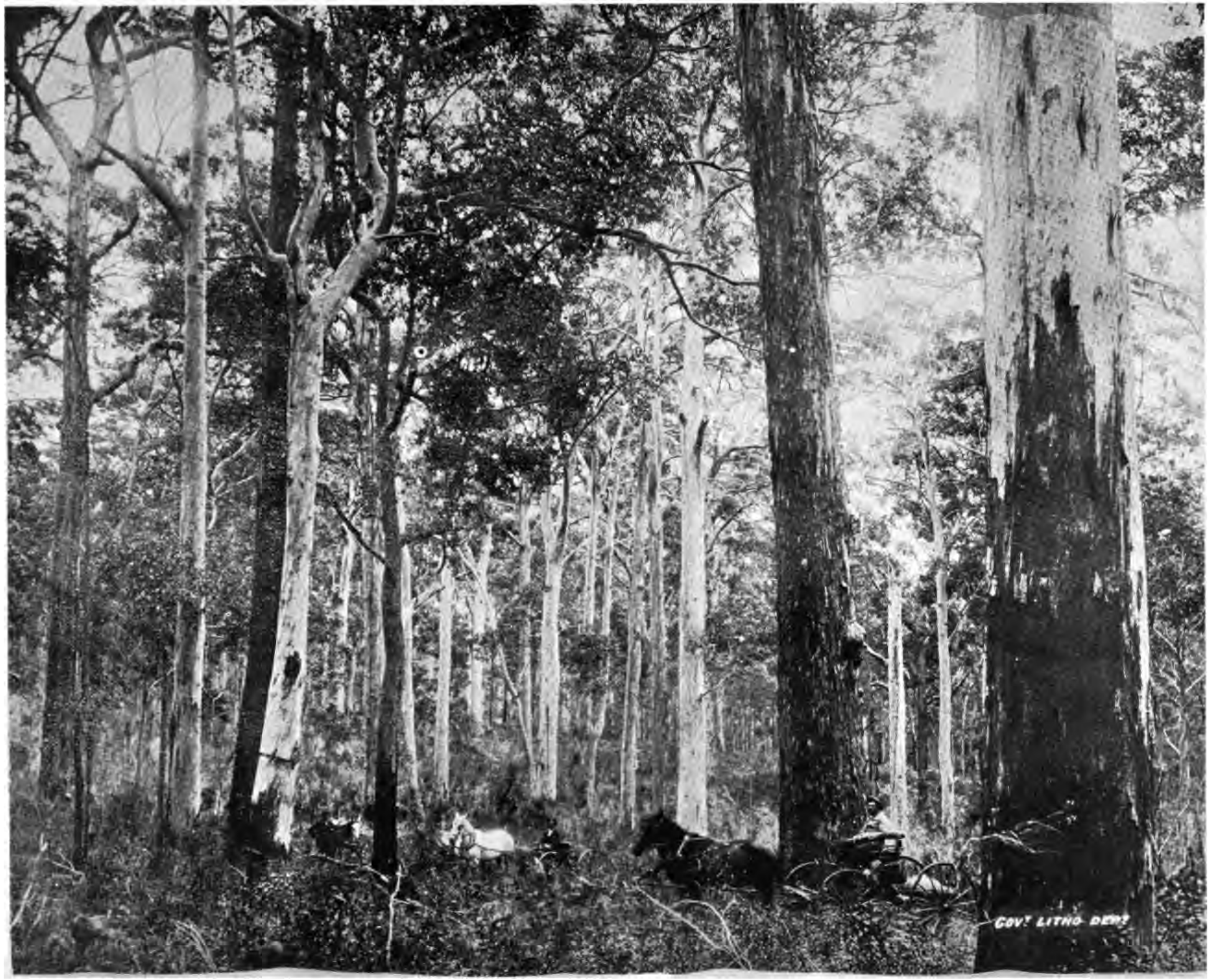


Felling a Jarrah Tree.

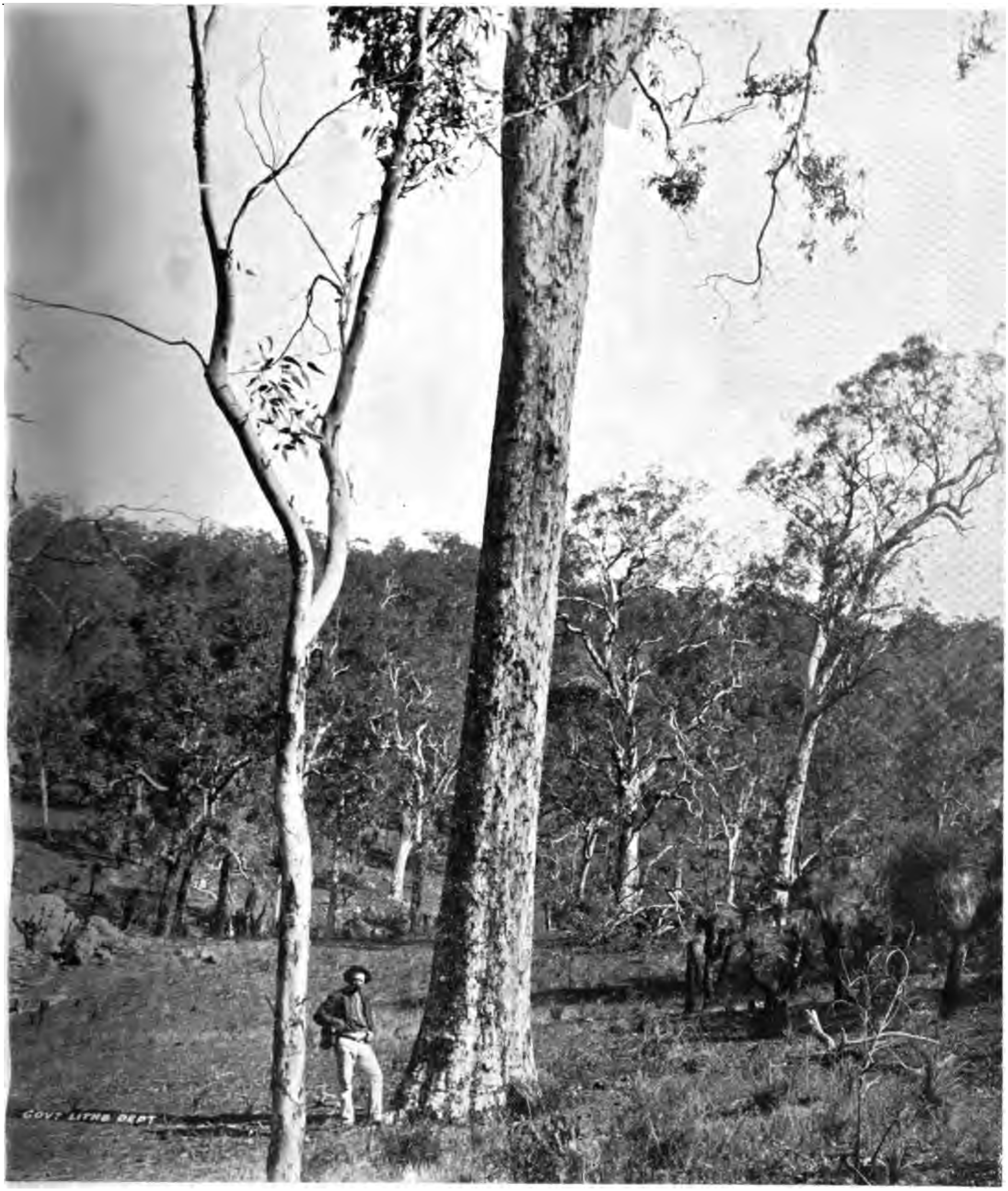


Karri Fo[illegible]

TUART FOREST.

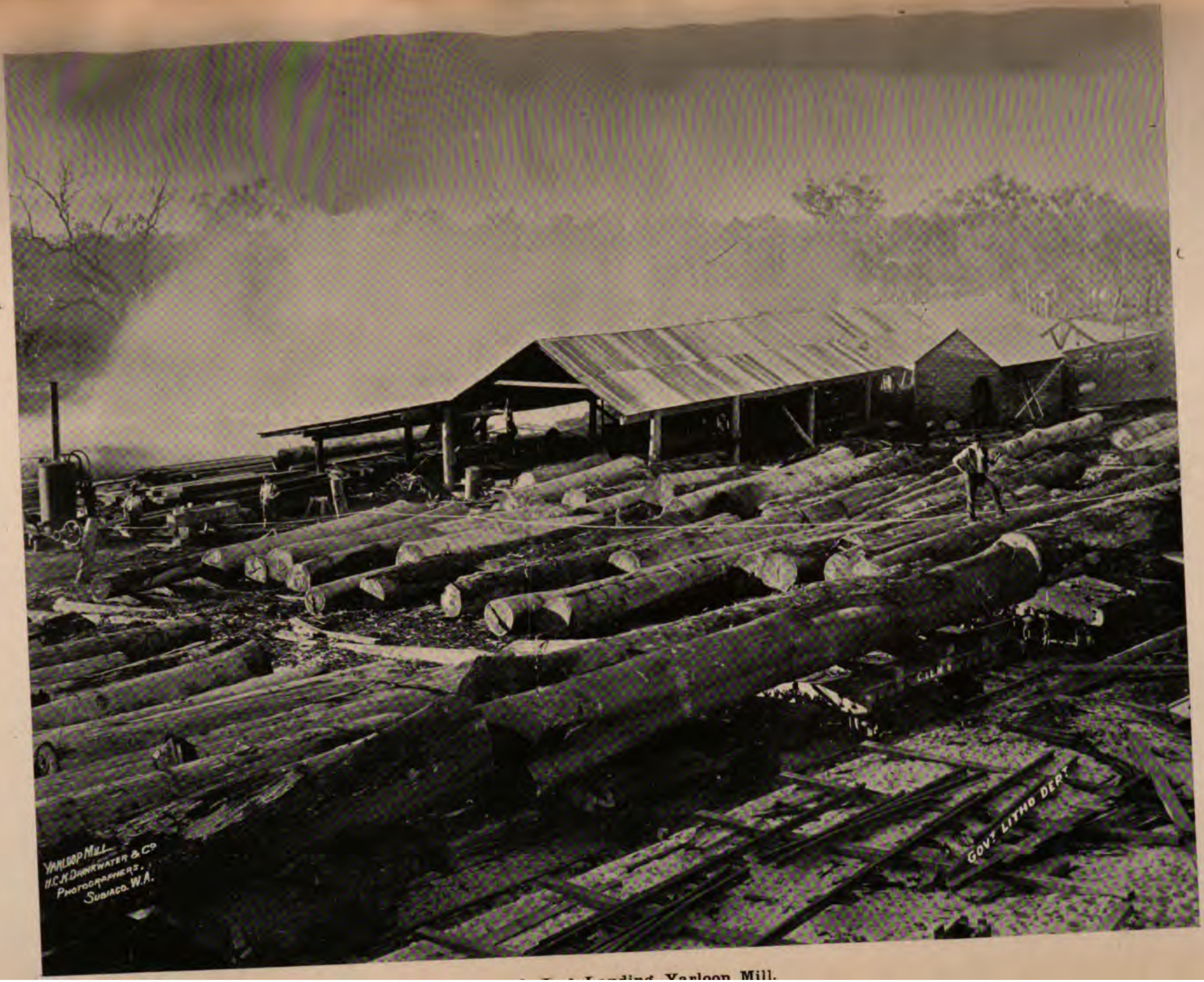


Karri Forest.

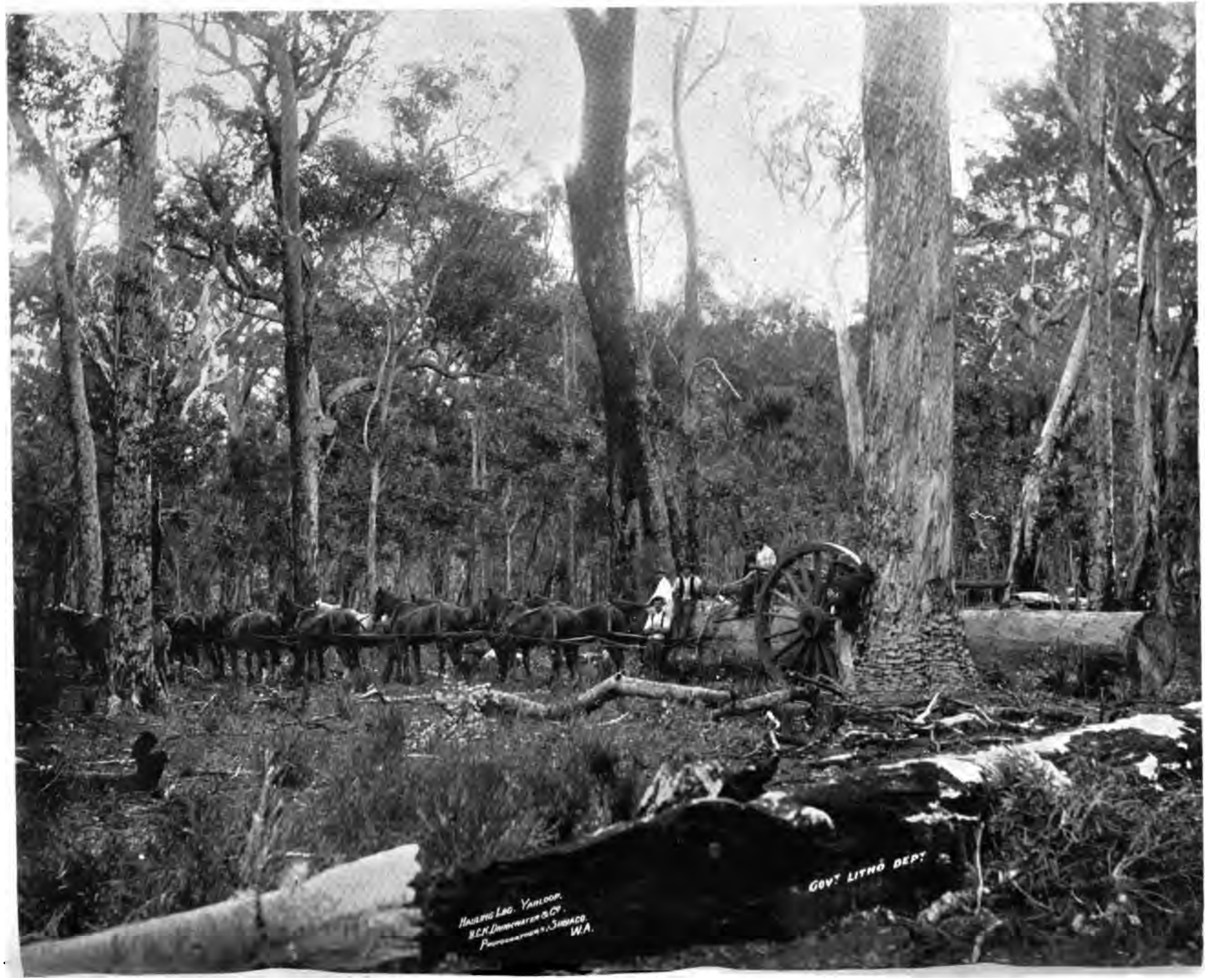


Wandoo Tree.

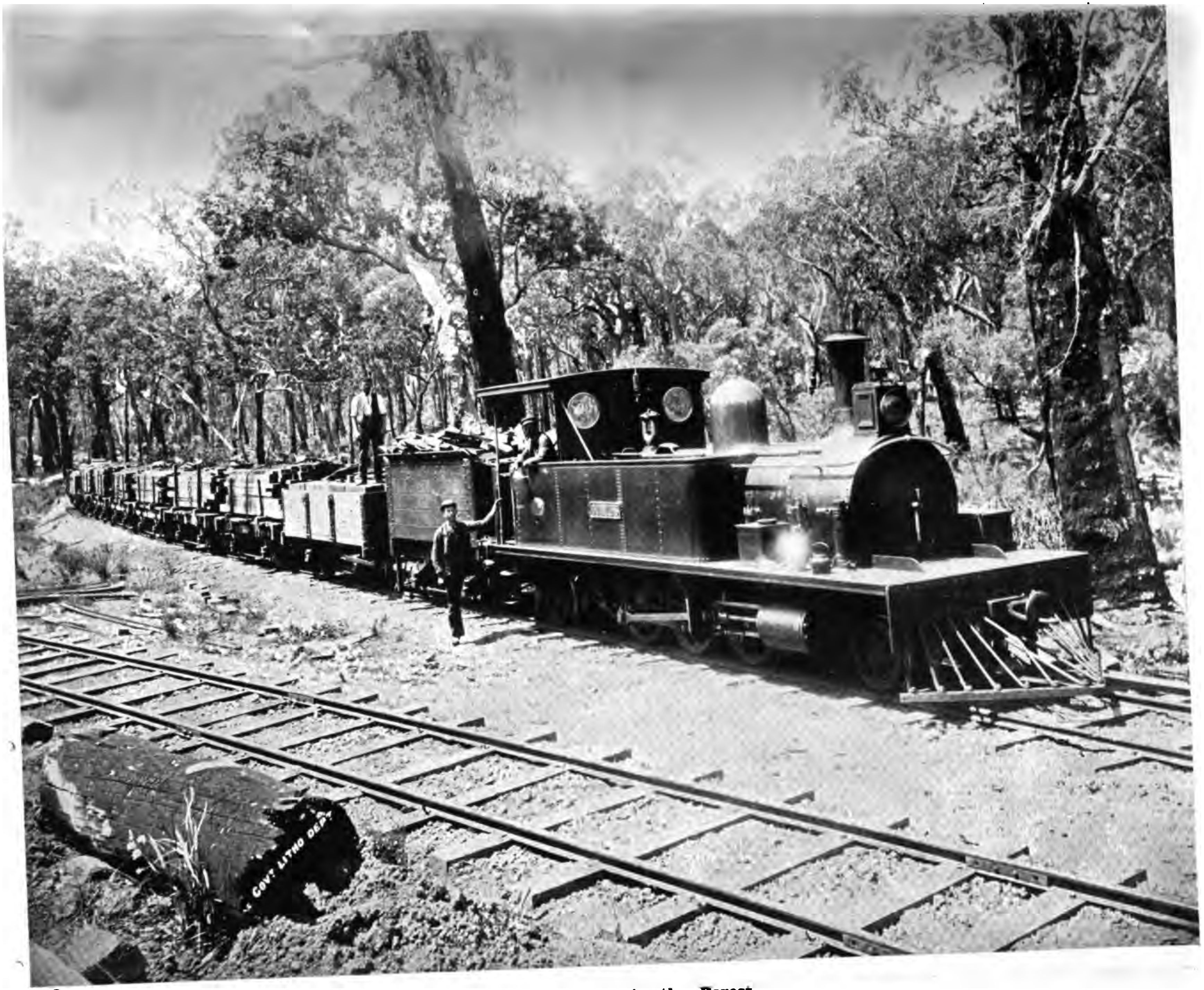
Hauling Jarrah Log.



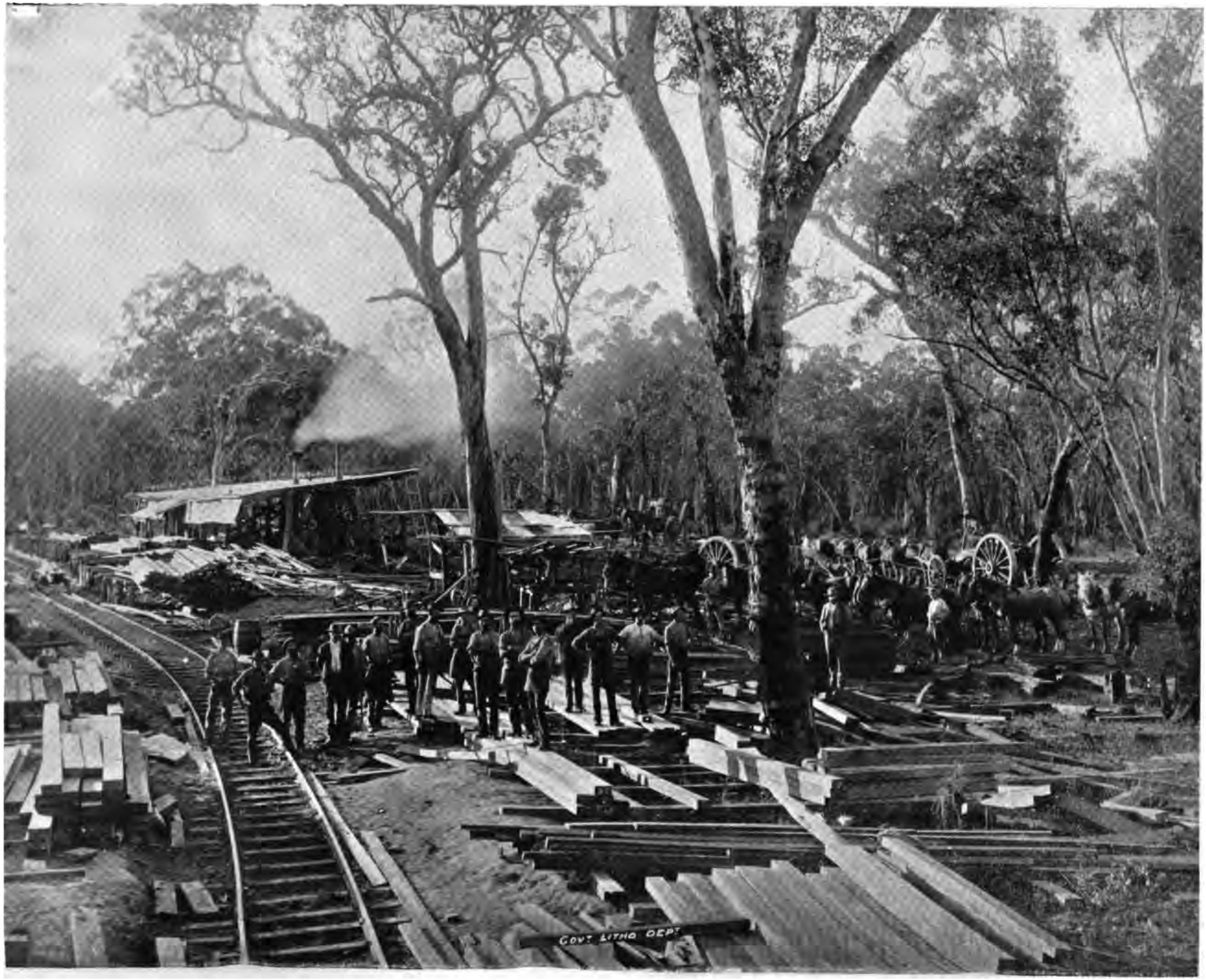
[illegible] Log Landing, Yarloop Mill.



Hauling Jarrah Log, Yarloop.

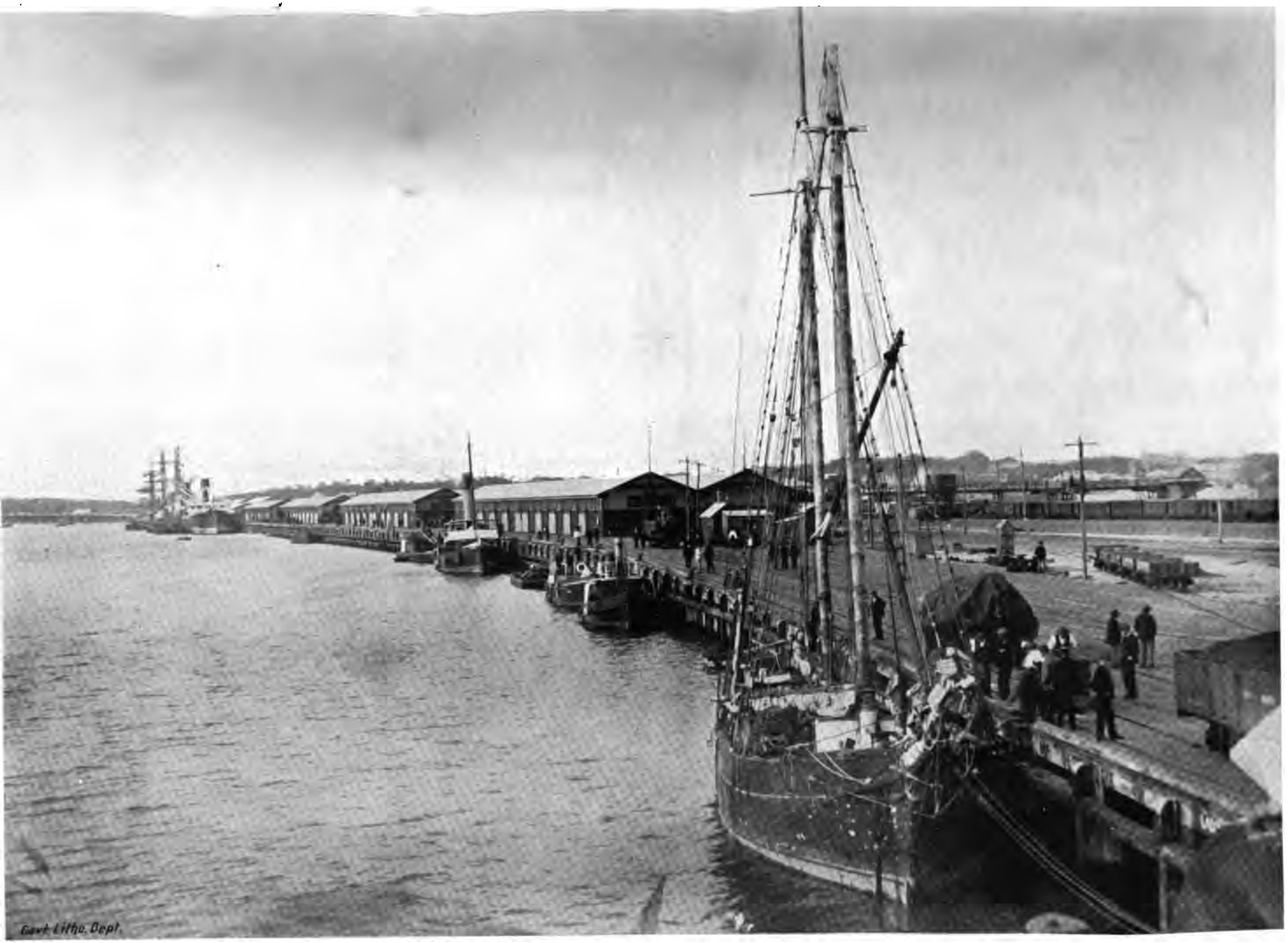


Hauling Timber in the Forest.

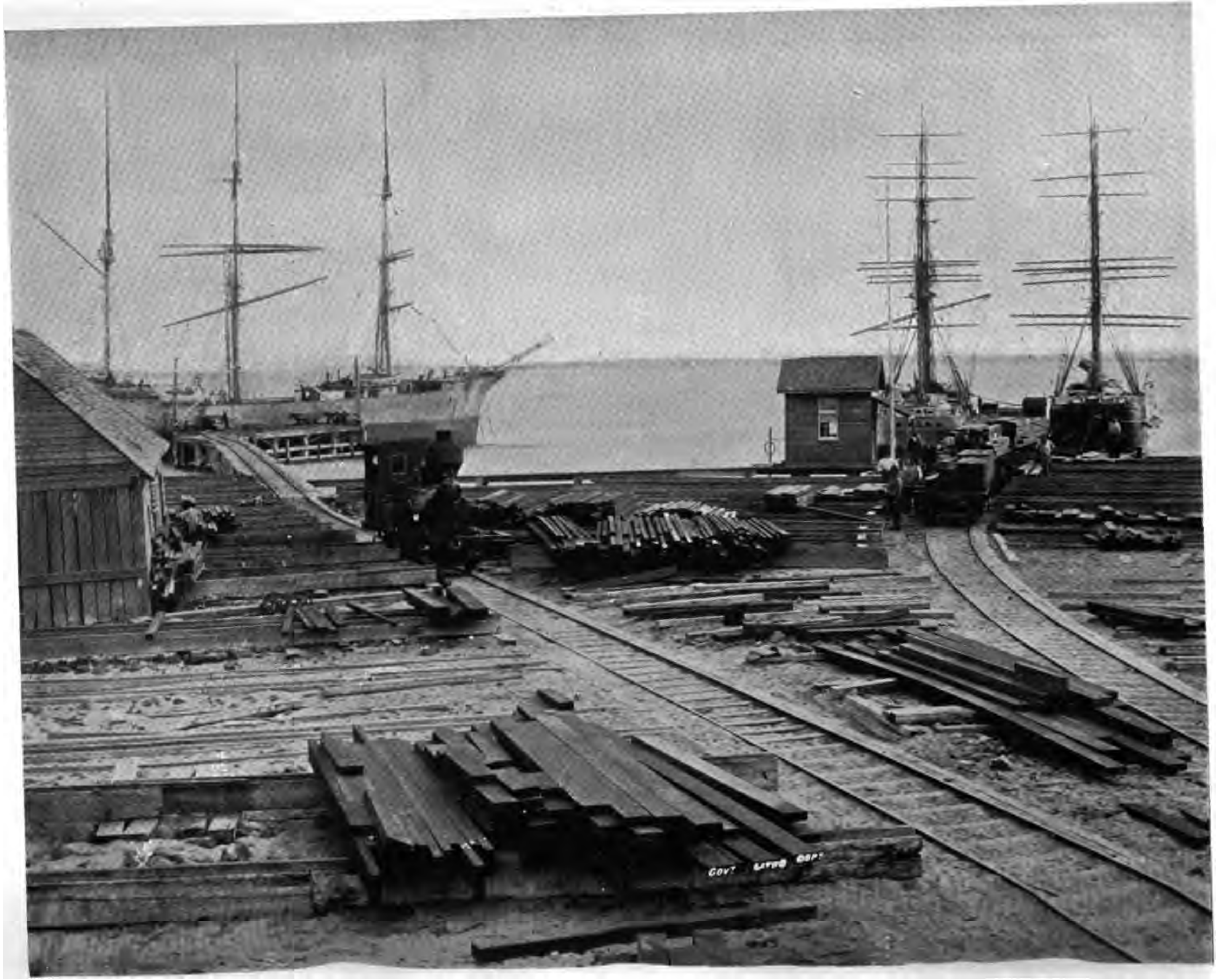


GOVT LITHO DEPT

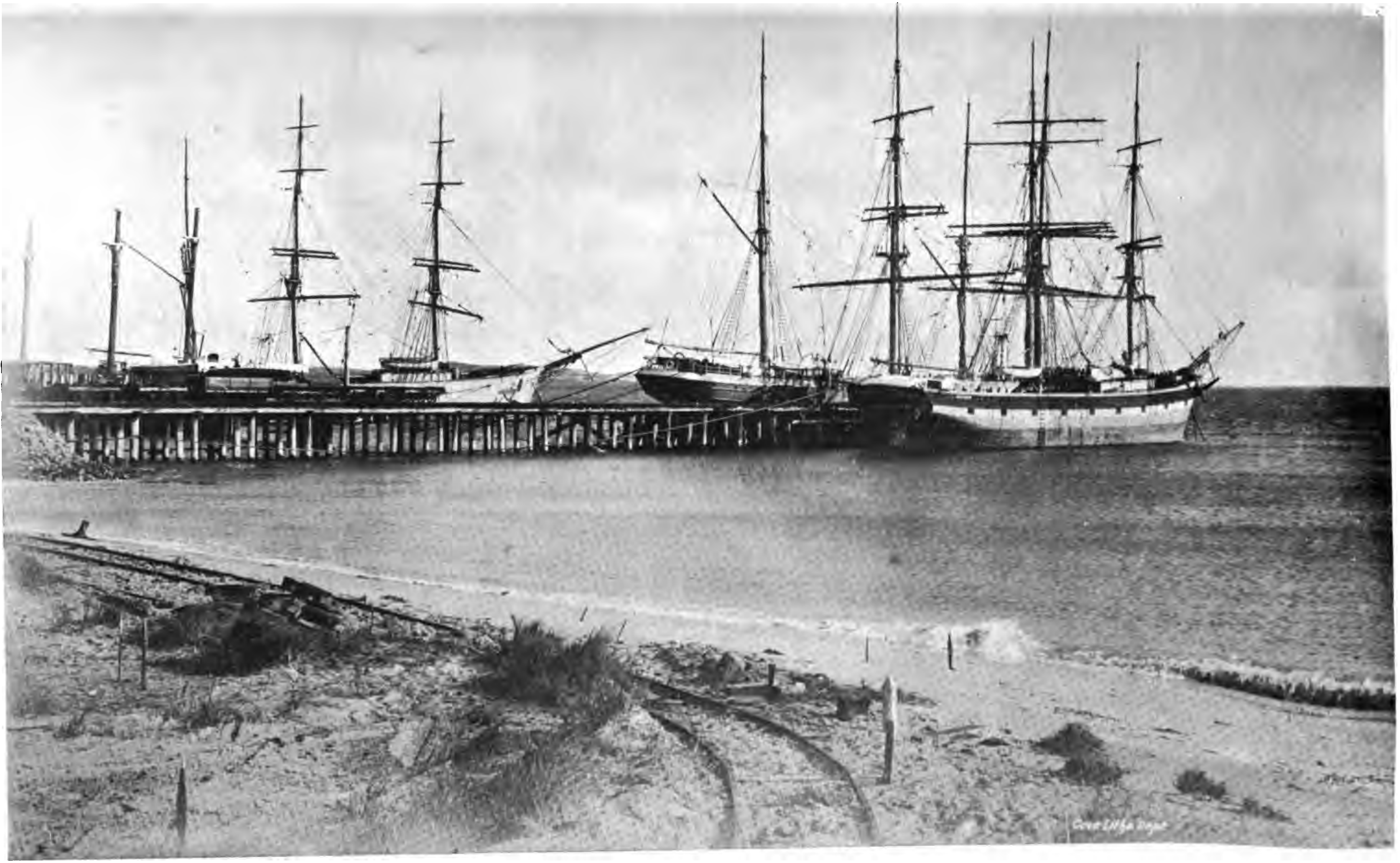
Bush Saw Mill.



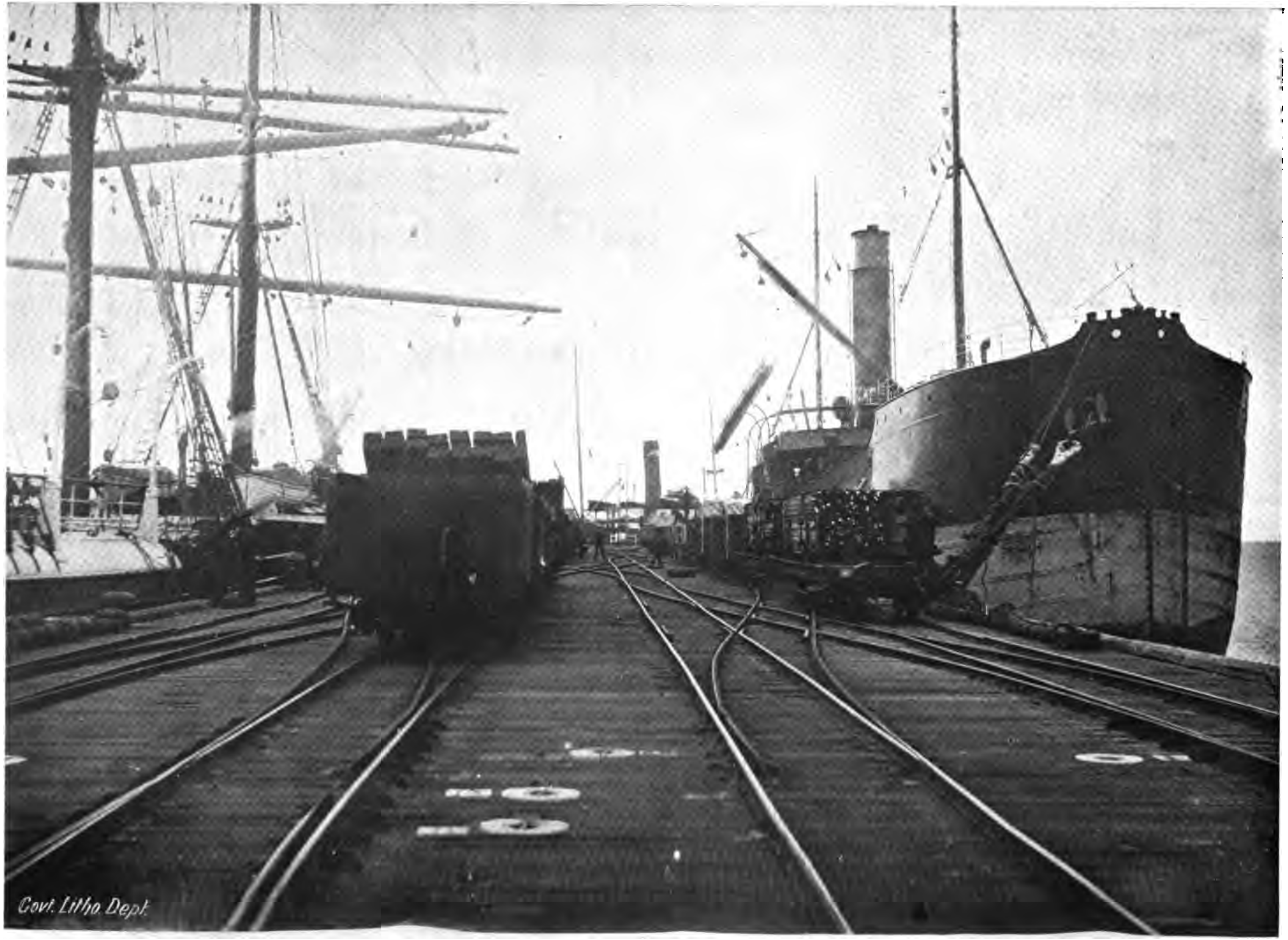
Victoria Quay, Fremantle Harbour.



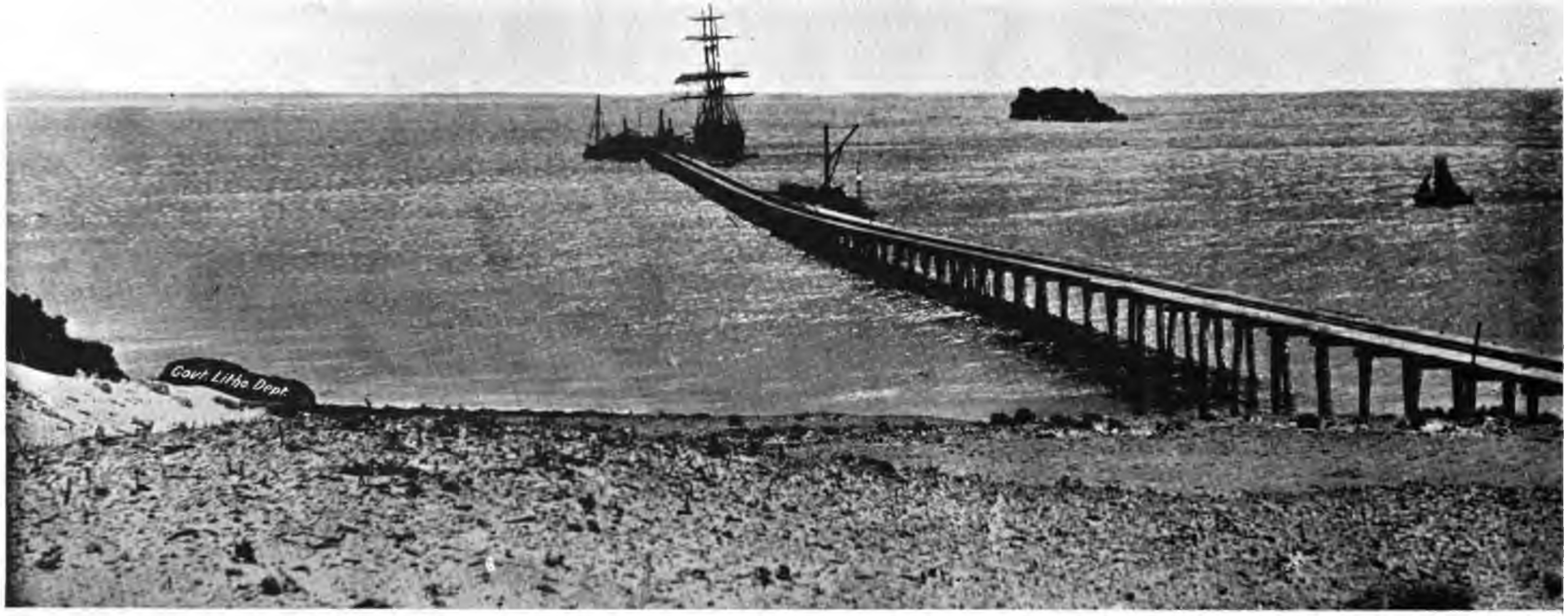
Rockingham Jetty.



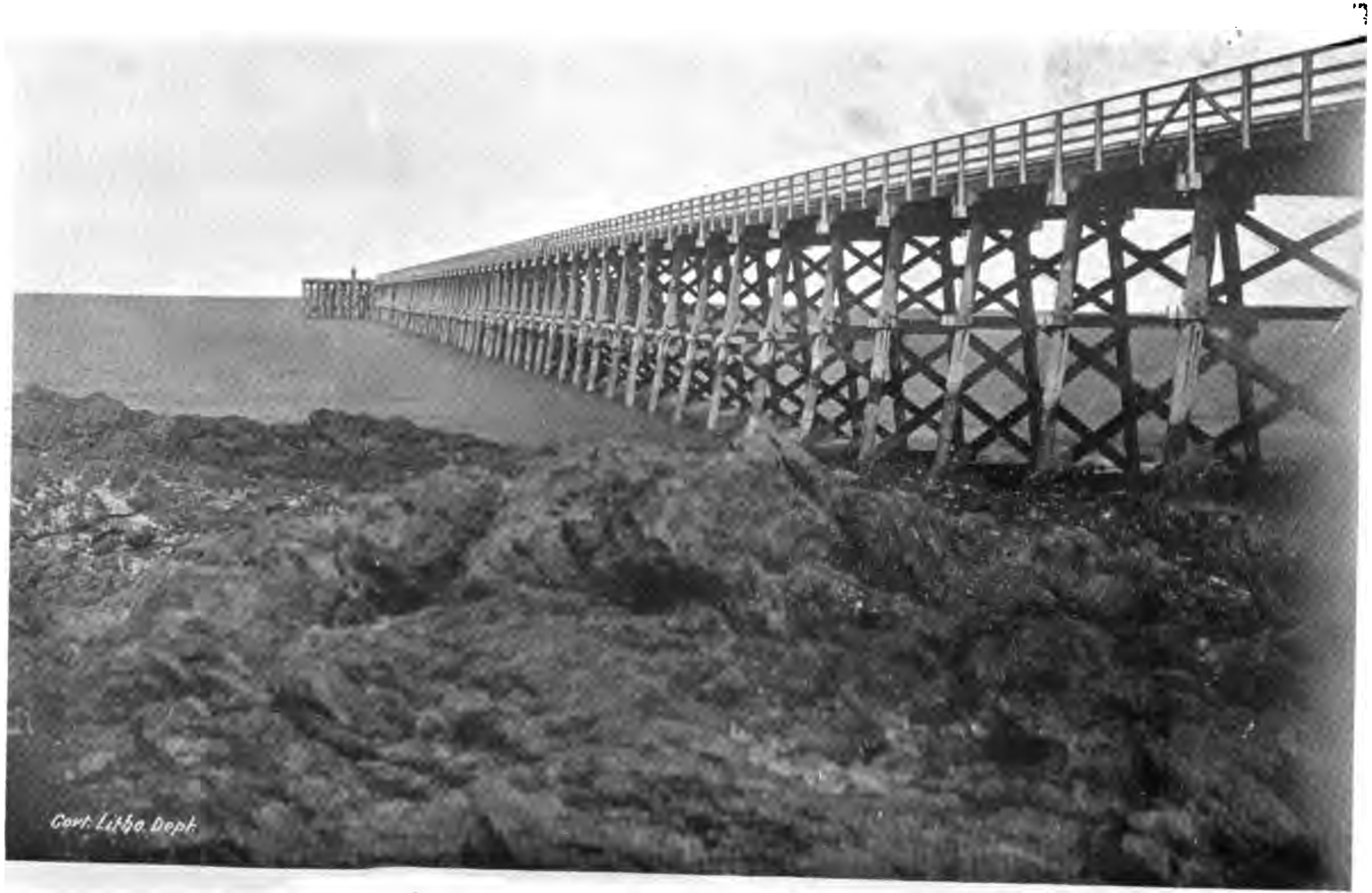
Loading Timber at Rockingham Jetty.



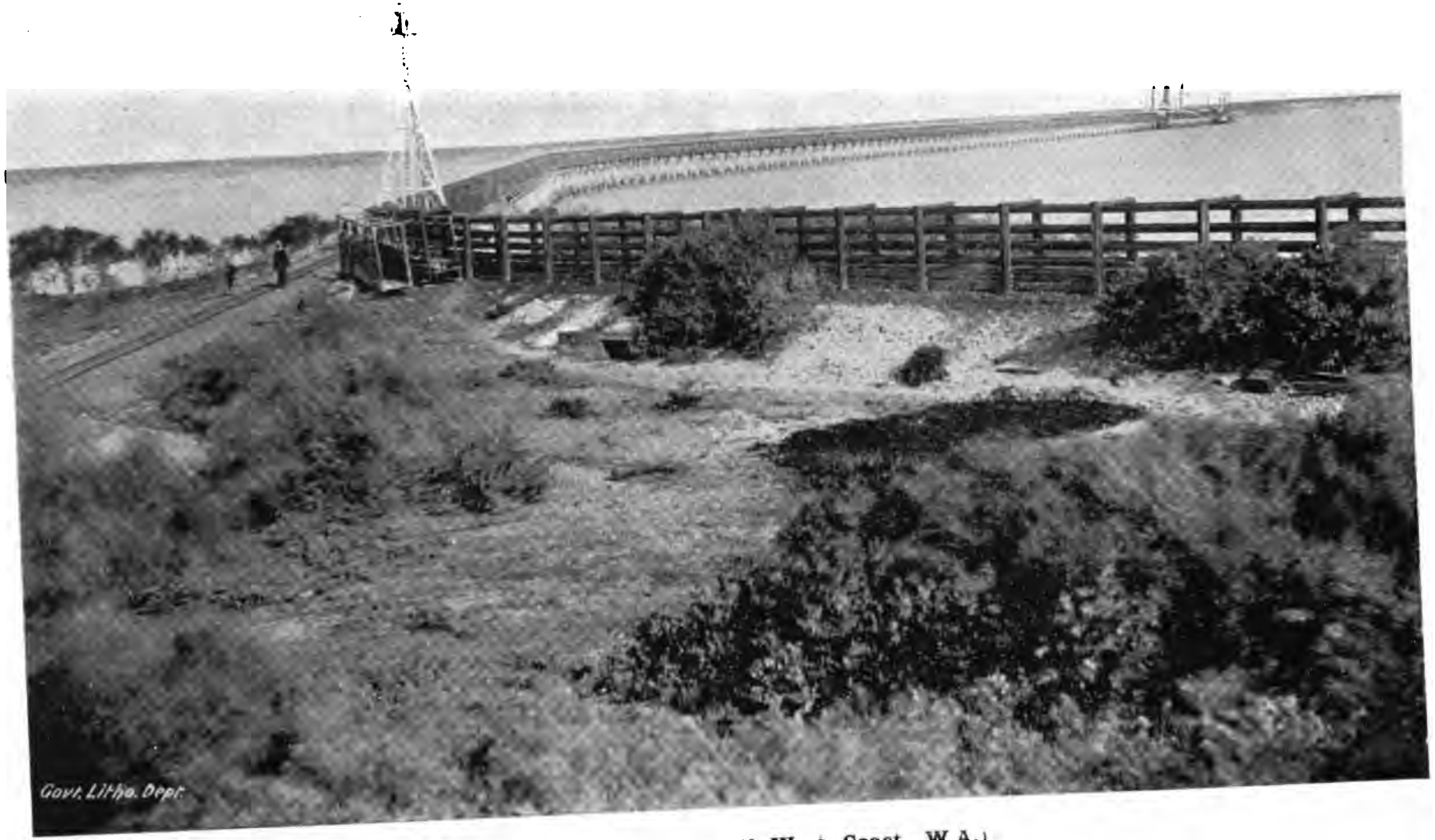
Loading Timber at Bunbury Jetty.



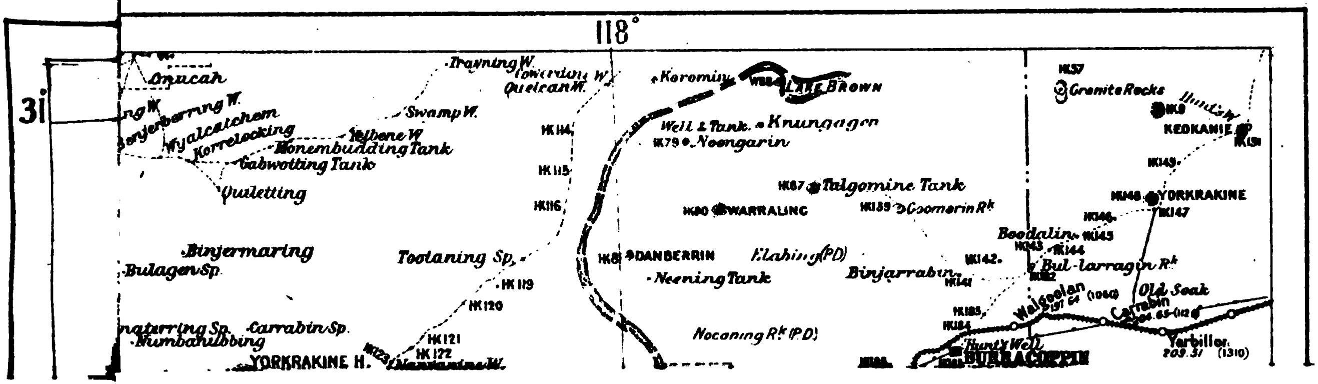
Loading Timber at Hamelin Jetty.



Jetty at Point Sampson, near Cossack (North-West Coast, W.A.)
Built of Jarrah Timber.



Jetty at Broome (North-West Coast, W.A.)
Built of Jarrab Timber.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31°
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Wyalcatchem
Korrelocking
Yelbene W.
Wonembudding Tank
Gabwotting Tank
Quiletting
Swamp W.
Trayning W.
Cowcowing W.
Quelcan W.
HK114
HK115
HK116
Binjermaring
Bulagen Sp.
Tootaning Sp.
HK119
HK120
Carrabin Sp.
Numbahubbing
HK121
HK122
HK123
YORKRAKINE H.
Koromin
LAKE BROWN
Well & Tank.
Knungagen
HK79
Noongarin
HK87
Talgomine Tank
HK80
WARRALING
HK139
Coomerin Rk
HK81
DANBERRIN
Elabing (P.D)
Neening Tank
Binjarrabin
Nocaning Rk (P.D)
HK57
Granite Rocks
HK9
KEDKANIE
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Boodalin
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HK143
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HK142
Bul-larragin Rk
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HK185
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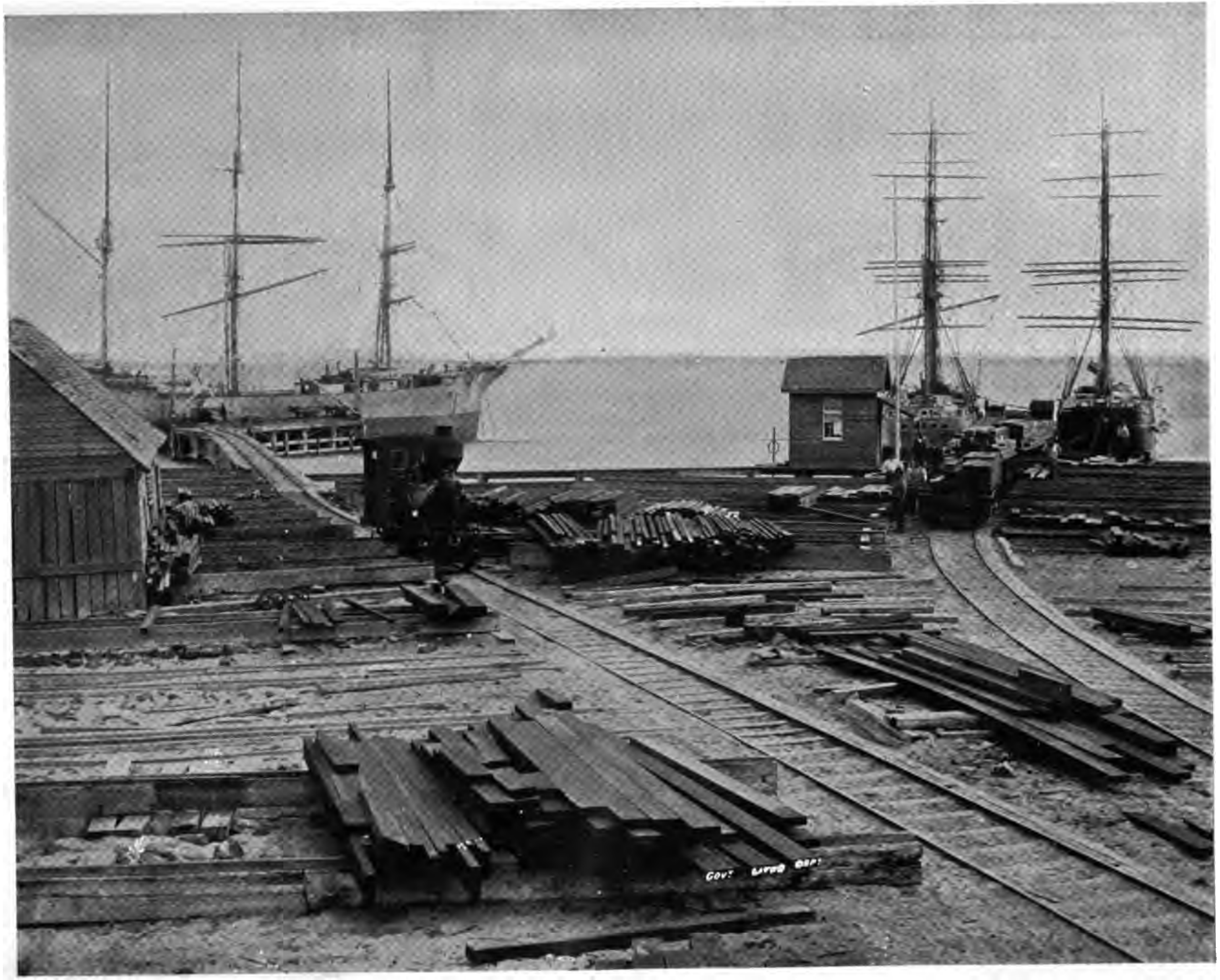
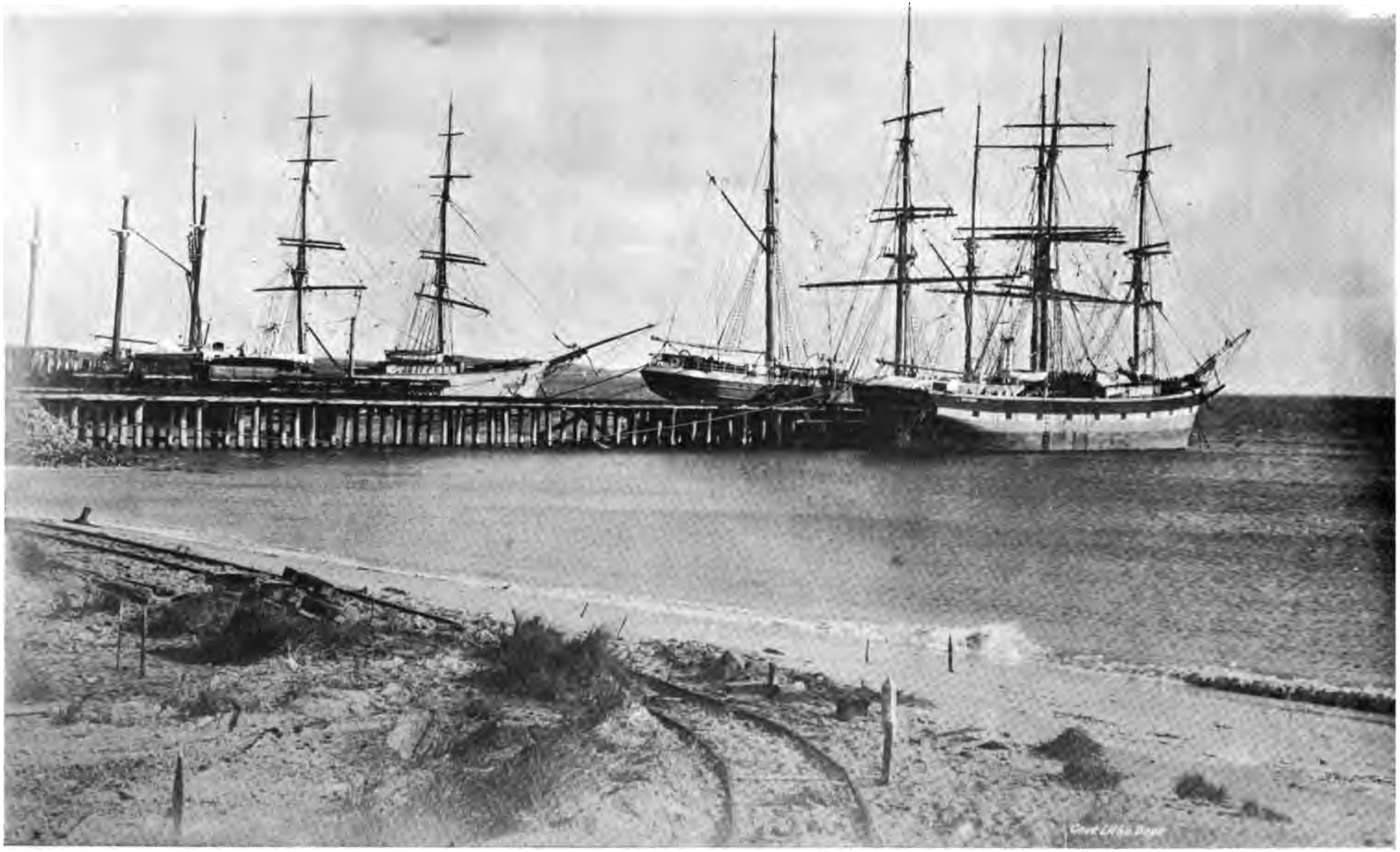
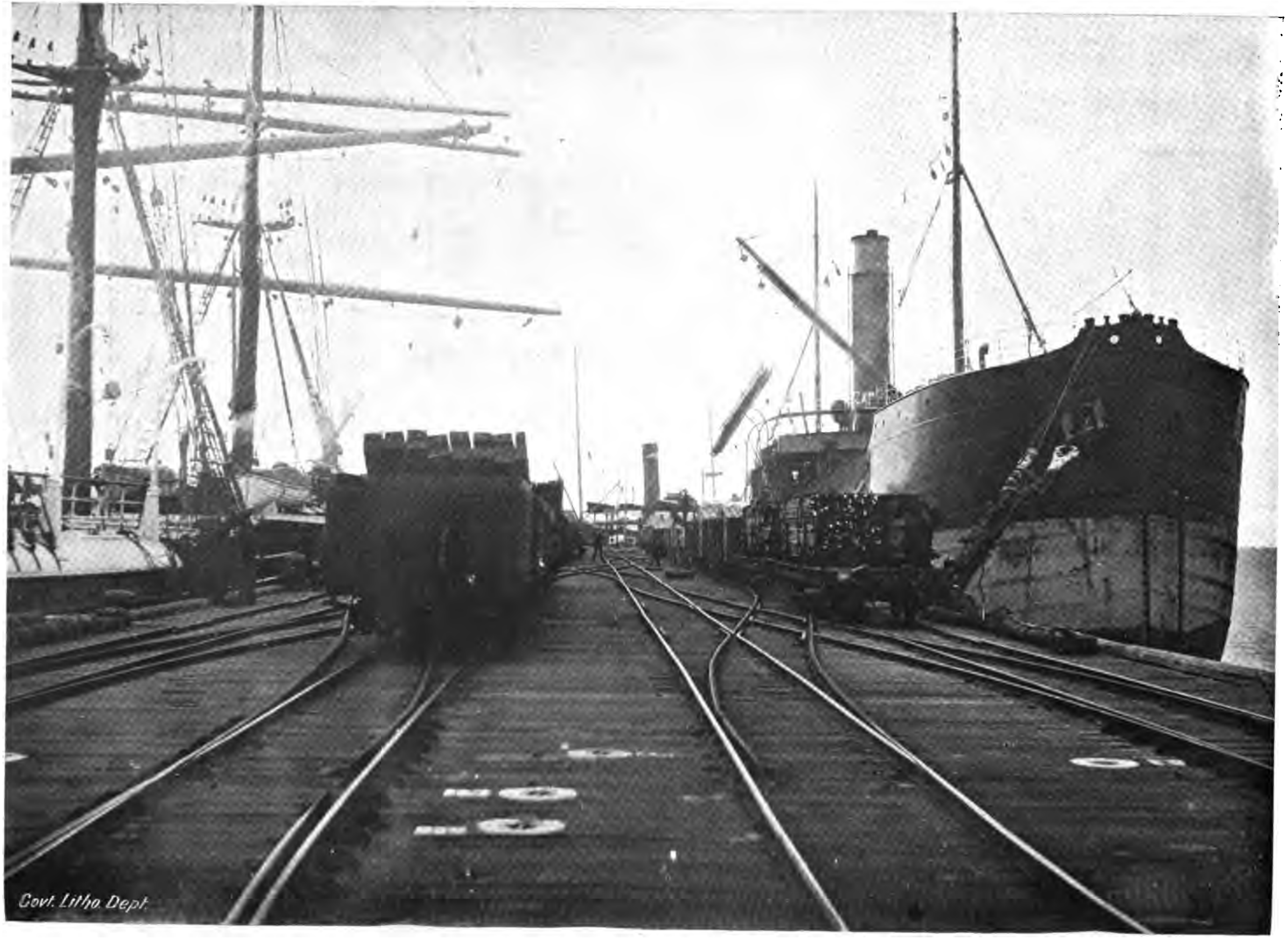
Carrabin
Yerbillon
209.31
(1310)
Hunt's Well
BURRACOPPIN



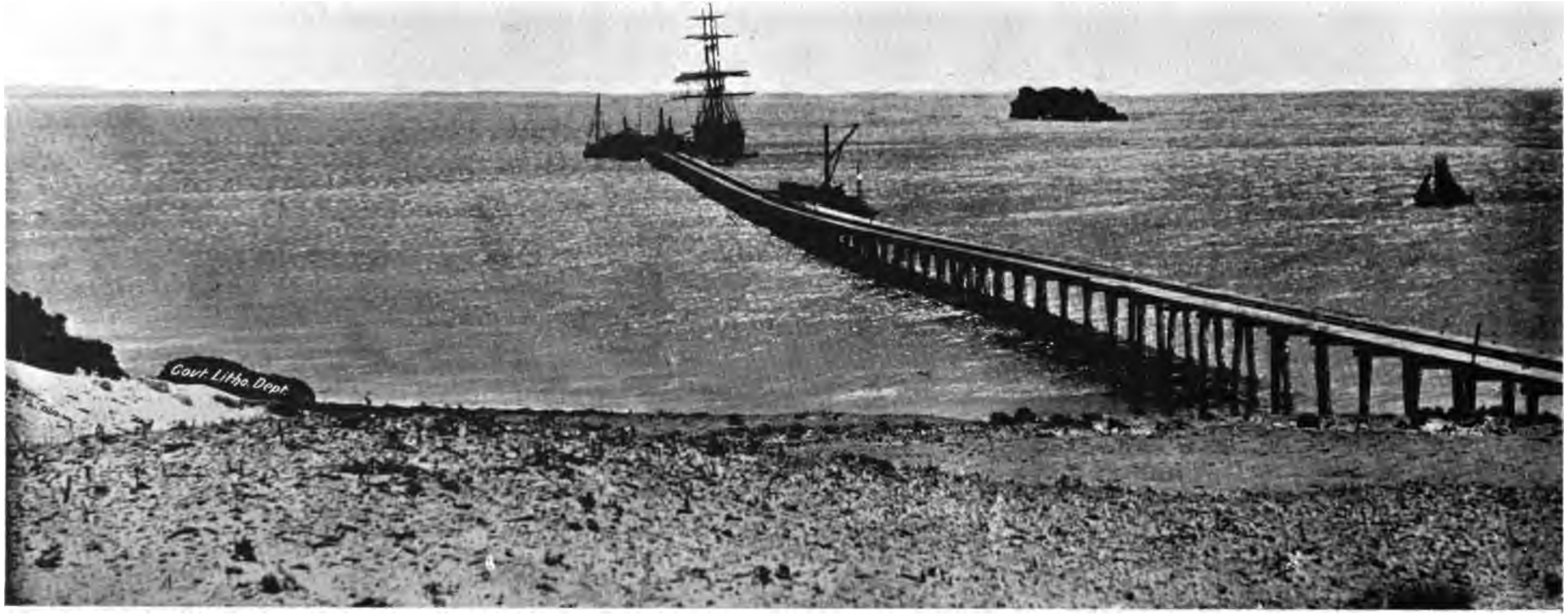
Rockingham Jetty.


Govt Litho Dept

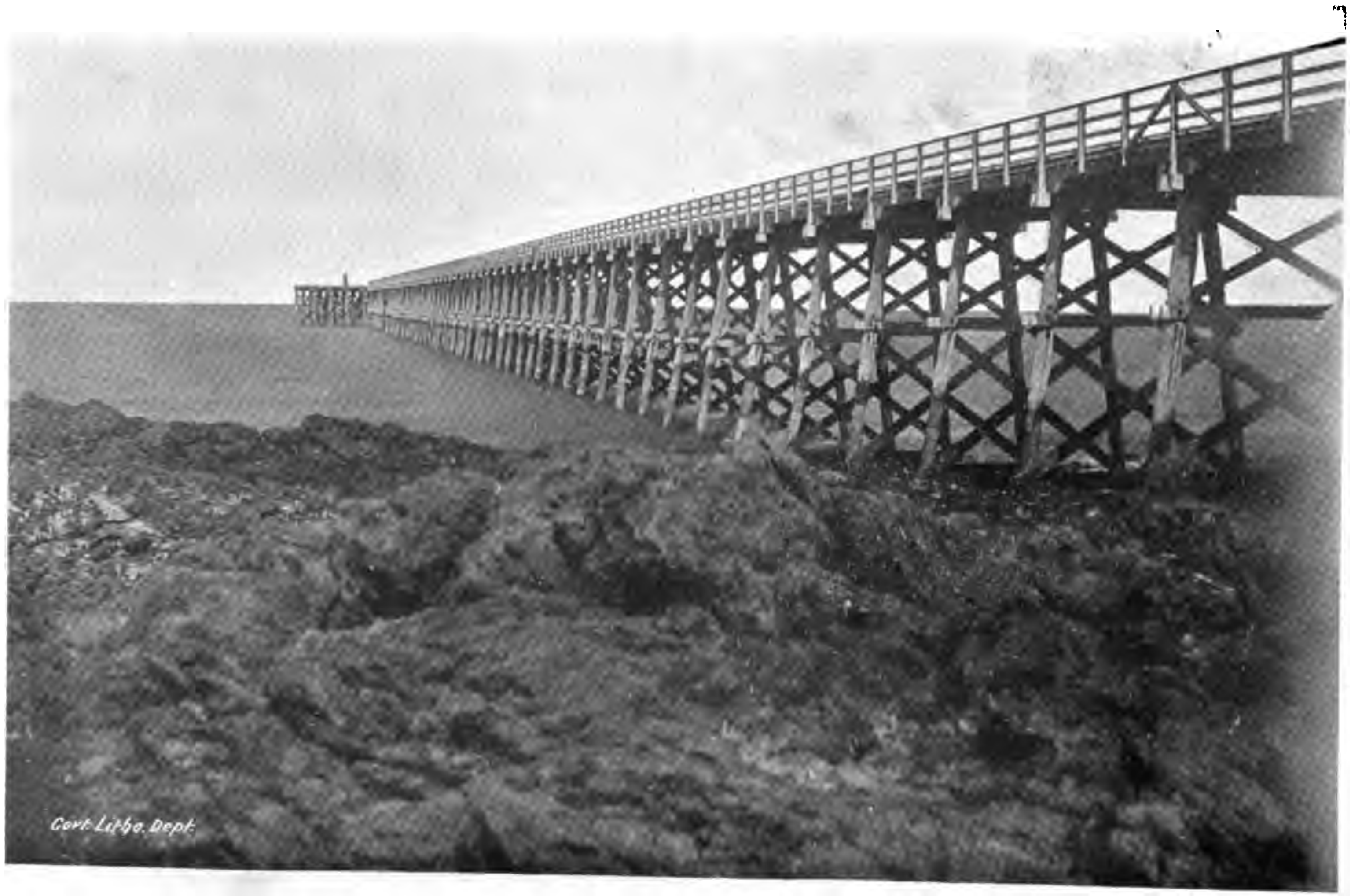
Loading Timber at Rockingham Jetty.



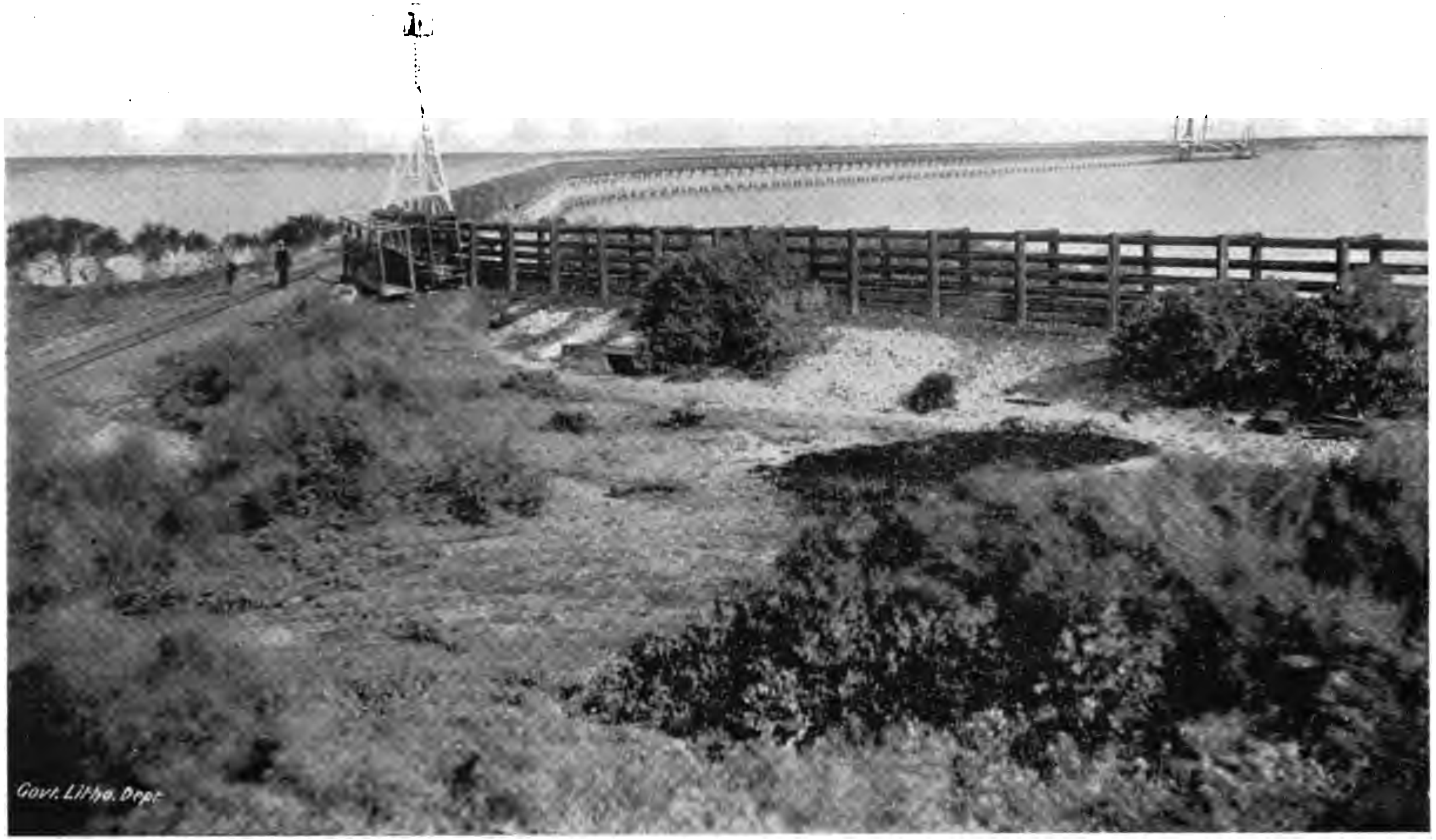
Loading Timber at Bunbury Jetty.



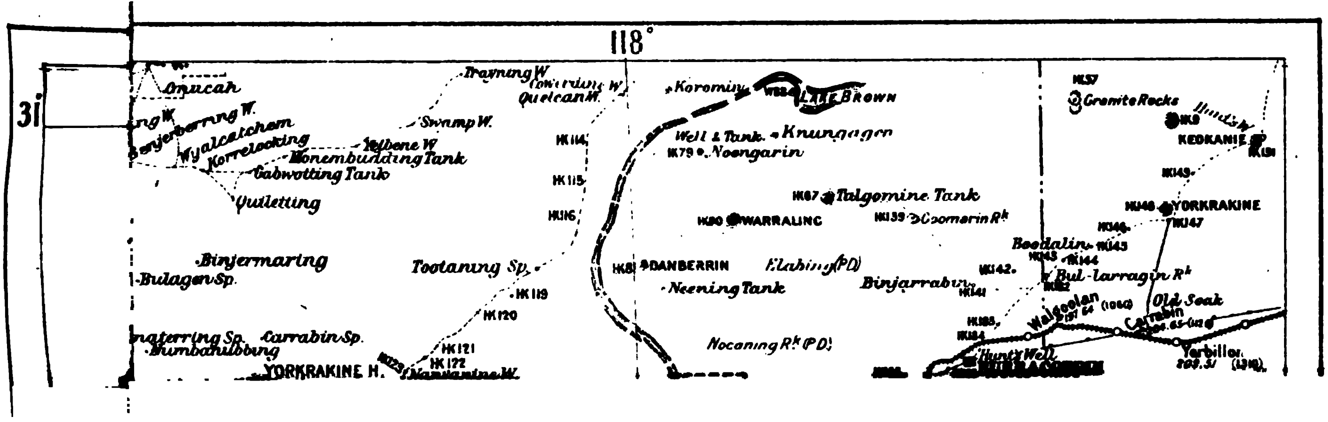
Loading Timber at Hamelin Jetty.



Jetty at Point Sampson, near Cossack (North-West Coast, W.A.)
Built of Jarrah Timber.



Jetty at Broome (North-West Coast, W.A.)
Built of Jarrah Timber.

118°
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Quelletting
Swamp W.
Trayning W.
Quelcan W.
HK114
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Binjermaring
Bulagen Sp.
Tootaning Sp.
HK119
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HK122
Carrabin Sp.
Bumbahubbing
YORKRAKINE H.
Koromin
Lake Brown
Well & Tank.
Knungagen
HK79
Noongarin
HK87
Talgomine Tank
HK90
WARRALING
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Coomerin Rk
HK81
DANBERRIN
Elabing (P.D)
Neening Tank
Binjarrabin
Nocaning Rk (P.D.)
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Hunt's Well
Boodalin
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Bul-larragin Rk
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Granite Rocks
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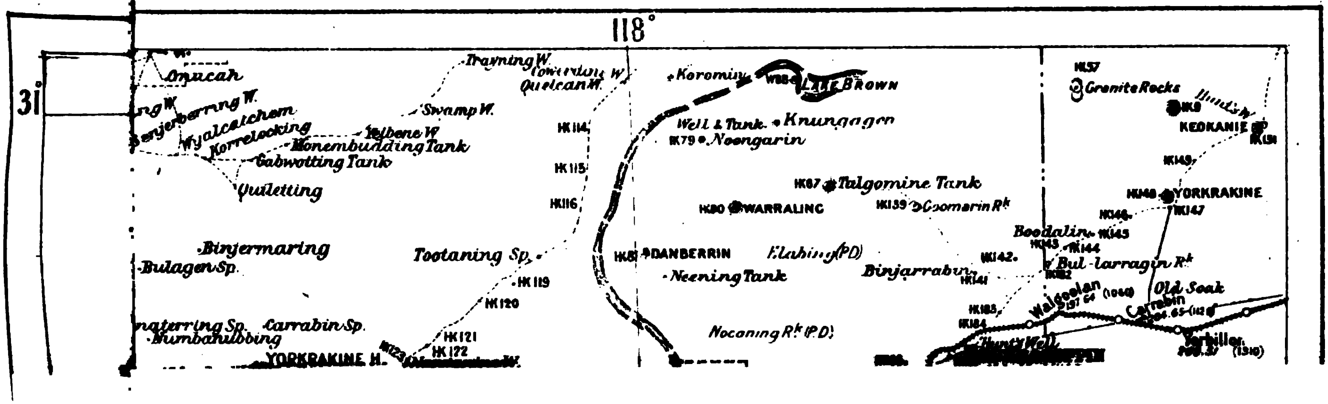
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Korrelocking
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Nonembudding Tank
Gabwotting Tank
Quiletting
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WB8
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197.64
(1040)
Carrabin
(1120)
Hunt's Well
Yerbillon
(1310)

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